THE NEED FOR A FIFTH SPACE SHUTTLE ORBITER

HEARING

BEFORE THE

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

NINETY-SEVENTH CONGRESS

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THE NEED FOR A FIFTH SPACE SHUTTLE ORBITER

TUESDAY, JUNE 15, 1982

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS,
Washington, D.C.

The subcommittee met, pursuant to notice, at 2:06 p.m., in room 2325, Rayburn House Office Building, Hon. Ronnie G. Flippo (chairman of the subcommittee) presiding.

Present: Representatives Flippo, Bouquard, Hollenbeck, McGrath, Winn, and Lowery.

Mr. FLIPPO. The subcommittee will come to order.

Without objection, we will have film coverage today.

Today the Subcommittee on Space Science and Applications is meeting to consider the requirements for increasing the size of the Space Shuttle orbiter fleet. If there is a need for additional orbiters, we must make a decision to move forward in the very near future to avoid the cost penalties associated with a production gap.

In the legislative report accompanying the fiscal year 1982 authorization bill, the committee requested that NASA and the Air Force review the requirements for additional orbiter vehicles and submit the results of this review to the Congress in December 1981. Unfortunately, this review was not completed in time for consideration during the fiscal year 1983 annual authorization process.

The subcommittee will also consider the viability of private sector acquisition of the fifth orbiter vehicle. The subcommittee understands that in February the Space Transportation Co. submitted to NASA a proposal to procure an orbiter vehicle in exchange for certain guarantees and submitted a revised proposal last month.

Again, while I do not want to prejudge the agency's assessment of this proposal, decisions must be made in a timely manner to assure full public discussion and congressional review.

I want to commend Congressman Hollenbeck, the ranking minority member of the subcommittee, for his interest and pursuit of the issues associated with the proposal by the Space Transportation Co.

Mr. Hollenbeck, do you have an opening statement?

Mr. HOLLENBECK. Yes, Mr. Chairman.

I am pleased with the timing of this hearing since, as you note, we are rapidly losing ground for making a cost-effective decision on a fifth or possibly additional orbiters.

NASA and its contractors are on the verge of making the space transportation system operational. What NASA and the contrac-

tors have achieved is creating a capability that was little more than a vision as Project Apollo ended in 1972.

Now a proven *Columbia* sits on pad 39A at the Kennedy Space Center. *Columbia* is the first of a fleet of operational spaceliners. The technicians, the engineers, the contractors, and the bureaucrats have done their job. They have created the spaceship that America will fly into the future.

Now we in Congress have to do our job. Decisions on buying additional shuttles, the role of the military and that of the private sector have to be examined.

The American taxpayer has footed the bill for more than $50 billion that it cost to launch the first Explorer spacecraft in 1958 through the fleet of Shuttles. President Kennedy called the early days of the Moon landing effort, "an investment based largely on faith." That faith and vision has paid off.

But major questions loom ahead. Four orbiters will be built. Some say there is a crying need for a fifth orbiter. At least one private company has offered to buy a fifth orbiter for NASA in exchange for exclusive marketing rights.

Should a private company be given the benefit of tax-paid research? Should NASA procure its own fifth orbiter and simply contract out launching and servicing of the Space Transportation System?

For years the military has supported NASA in its quest for additional Shuttle funding. Yet its only monetary contribution to the Shuttle program is in the investment at the Vandenberg Air Force Base launch facility. Is it time now for the military to procure its own orbiters out of its own budget?

Do we want to mix a military and civilian fleet, thus sacrificing the traditional openness that has been the symbol of the American space program? On the flight set to take off June 27 there is a military payload on board. Is it time to consider the idea of procuring Shuttles that carry the symbol of the Air Force and fly strictly military missions?

By forcing joint operations, are we not compromising NASA's openness and the Air Force's need for security? If the fleet is made available to private marketeers of cargo space, what effect does this have on NASA's scheduling and the military's security?

And what of NASA's future? What happens to this marvelous agency that has taken on tasks that have transformed imagination into reality with such dispatch? What will be its next task?

The procurement of future Shuttle orbiters is a broad question because it requires us to think about a whole new range of options. We must decide not just how and if we are going to fund a fifth orbiter but what we want to do with these wonderful machines.

If NASA officials are not going to launch the Shuttles, then what role will the space agency undertake? Will it be to build space stations or to develop some more advanced form of Shuttle?

Frank O'Conner, the Irish writer, once told a story of how two boys would come to a wall or an obstacle that was too high or too hard to climb. To complete their journey, the boys would toss their hats over the wall and be forced to explore the wonders on the other side.

We are on the other side, and now we have to decide which wonders we are going to explore and in how many ships.

Thank you, Mr. Chairman. I have additional remarks which I would ask permission to revise and extend for the record.

Mr. FLIPPO. Without objection, it is so ordered.

[The opening statement of Mr. Hollenbeck follows:]

HONORABLE HAROLD C. HOLLENBECK

OPENING STATEMENT

JUNE 15, 1982

THANK YOU, MR. CHAIRMAN. I JOIN WITH YOU AND MY COLLEAGUES IN WELCOMING OUR DISTINGUISHED WITNESSES BEFORE THE SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS. I AM PARTICULARLY PLEASED WITH THE TIMING OF THIS HEARING SINCE WE ARE NOW RAPIDLY LOSING GROUND FOR MAKING A COST EFFECTIVE DECISION ON A FIFTH, OR POSSIBLY, ADDITIONAL ORBITERS.

I HAVE LEARNED THAT THE SPACE SHUTTLE THIRD TIER SUBCONTRACTORS HAVE COMPLETED WORK FOR ORBITER 104, AND WITHOUT A COMMITMENT FOR A FIFTH SHUTTLE, MANY OF THESE COMPANIES WILL EITHER GO OUT OF BUSINESS OR MOVE ON TO OTHER WORK. WE ALL REALIZE WHAT THIS MEANS: EITHER COMMIT NOW TO AN ADDITIONAL ORBITER FOR $1 BILLION, OR BE WILLING TO PAY AT LEAST $2 TO $2.5 BILLION LATER ON DOWN THE ROAD.

THIS BRINGS ME TO MY SECOND POINT. HOW BAD DO WE NEED A FIFTH SPACE SHUTTLE? CAN A FOUR ORBITER FLEET HANDLE THE PROJECTED 40 LAUNCHES PER YEAR SCHEDULED FOR 1991? WHAT DOES NASA, DOD, AIAA, SPACE TRANS, AND BOEING BELIEVE TO BE THE PROPER FLEET SIZE FOR THIS LAUNCH RATE?

AS YOU RECALL, IN FEBRUARY OF THIS YEAR WE LEARNED OF A PROPOSAL THAT HAD BEEN SUBMITTED BY THE SPACE TRANSPORTATION COMPANY (STC) TO NASA. SPACE TRANS PROPOSES TO PURCHASE THE FIFTH ORBITER IN RETURN FOR EXCLUSIVE MARKETING RIGHTS

OF ALL COMMERCIAL AND FOREIGN PAYLOADS ABOARD THEIR SHUTTLE. SINCE THE TIME OF THIS INITIAL SUBMISSION, I HAVE MET WITH SPACE TRANS AND NASA OFFICIALS TO DISCUSS THE FEASIBILITY OF SUCH A PROPOSAL. AS I UNDERSTAND, THERE WERE A NUMBER OF DISCUSSION POINTS FOLLOWING THE FIRST EVALUATION. SUBSEQUENTLY THE PROPOSAL HAS BEEN REVISED AND RESUBMITTED TO NASA.

SO NOW, MR. CHAIRMAN, WE ARE AT A CROSSROADS FOR OUR SUBCOMMITTEE: SUBCONTRACTORS RUNNING OUT OF SHUTTLE WORK, NO FUNDS REQUESTED BY THE ADMINISTRATION IN FISCAL YEAR 1983 FOR A FIFTH ORBITER, NASA NOW TELLING US THEY NEED MORE THAN A FOUR ORBITER FLEET, AND A PROPOSAL BY AN INSURANCE COMPANY-BACKED ORGANIZATION TO BUY THE FIFTH SHUTTLE. ALL OF THESE ISSUES ARE RELATED SINCE WE MUST DECIDE NOW WHETHER TO GO AHEAD AND BUILD A FIFTH ORBITER, AND IF WE DO SO SHOULD WE CONSIDER PRIVATE FINANCING?

SINCE I LEARNED OF THE SPACE TRAN'S PROPOSAL IN JANUARY, I MET WITH OUR LEGISLATIVE COUNSEL TO SEE IF LEGISLATION WOULD BE REQUIRED FOR THIS CONTRACT. COUNSEL HAS RAISED SEVERAL ISSUES RELATED TO THE "ANTI-DEFICIENCY ACT" WHICH PROVIDES:

> "NO OFFICER OR EMPLOYEE OF THE UNITED STATES SHALL MAKE OR AUTHORIZE AN EXPENDITURE FROM OR CREATE OR AUTHORIZE AN OBLIGATION UNDER ANY APPROPRIATION OR FUND IN EXCESS OF THE AMOUNT AVAILABLE THEREIN; NOR

SHALL ANY SUCH OFFICER OR EMPLOYEE INVOLVE THE GOVERNMENT IN ANY CONTRACT OR OTHER OBLIGATION, FOR THE PAYMENT OF MONEY FOR ANY PURPOSE, IN ADVANCE OF APPROPRIATIONS MADE FOR SUCH PURPOSE, UNLESS SUCH CONTRACT OR OBLIGATION IS AUTHORIZED BY LAW."

SPACE TRANS DESCRIBED THAT THEY WOULD PROPOSE TO NASA TWO TYPES OF CONTRACTUAL ARRANGEMENTS CONCERNING THE FINANCING OF THE FIFTH SPACE SHUTTLE ORBITER. UNDER THE FIRST OF SUCH ARRANGEMENTS, STC WOULD PAY MONEY TO NASA AND IN RETURN NASA WOULD PROCURE (THROUGH A CONTRACT WITH ROCKWELL INTERNATIONAL) AND FLY THE ORBITER FOR STC AND WOULD GRANT EXCLUSIVE RIGHTS TO MARKET THE AVAILABLE PAYLOAD SPACE ON THE PARTICULAR ORBITER. UNDER A SECOND PROPOSED AGREEMENT, STC WOULD PAY MONEY TO ROCKWELL INTERNATIONAL TO CONSTRUCT THE FIFTH ORBITER AND, IN A SEPARATE TRANSACTION, STC WOULD PAY MONEY TO NASA AND NASA, IN RETURN, WOULD FLY THE ORBITER AND WOULD GRANT EXCLUSIVE MARKETING RIGHTS TO STC.

WITH RESPECT TO THE CONTRACTUAL ARRANGEMENTS PROPOSED BY STC, THIS PROVISION OF THE ANTI-DEFICIENCY ACT RAISES TWO ISSUES.

THE FIRST ISSUE IS WHETHER SECTION 203(c)(5) OF THE NATIONAL AERONAUTICS AND SPACE ACT, WHICH PROVIDES NASA'S CONTRACTING AUTHORITY, ALLOWS NASA TO MAKE CONTRACTS (SUCH

AS THOSE PROPOSED BY STC) FOR THE PAYMENT OF MONEY BEFORE AN APPROPRIATION IS MADE, NOTWITHSTANDING THIS PROVISION OF THE ANTI-DEFICIENCY ACT. THE SECTION 203(c)(5) SPECIFICALLY WAIVES SECTION 3648 OF THE REVISED STATUTES (31 U.S.C. 529) WHICH PROVIDES IN RELEVANT PART:

> "NO ADVANCE OF PUBLIC MONEY SHALL BE MADE IN ANY CASE UNLESS AUTHORIZED BY THE APPROPRIATION CONCERNED OR OTHER LAW."

ONE ARGUMENT, BASED ON A STRICT READING OF THE LANGUAGE, WOULD BE THAT THIS WAIVER ALLOWS NASA TO MAKE PAYMENTS UNDER A CONTRACT WITHOUT EVER RECEIVING AN APPROPRIATION WITH RESPECT TO A PARTICULAR CONTRACT. THE OTHER ARGUMENT IS THAT THIS WAIVER SIMPLY ALLOWS NASA TO TEMPORARILY MAKE PAYMENTS UNDER A CONTRACT BEFORE AN APPROPRIATION IS MADE, BUT WOULD REQUIRE NASA, EVENTUALLY, TO DEDUCT THESE PAYMENTS FROM AN APPROPRIATION MADE FOR A SPECIFIC PURPOSE. THE SECOND ARGUMENT IS STRENGTHENED BY THE FACT THAT THE CONGRESS DID NOT WAIVE THIS PROVISION OF THE ANTI-DEFICIENCY ACT IN SECTION 203(c)(5).

REGARDLESS OF THE EXISTENCE OF AN ADVANCE APPROPRIATION TO NASA TO CARRY OUT THE CONTRACTUAL ARRANGEMENTS PROPOSED BY SPACE TRANS, THE SECOND ISSUE RAISED UNDER THIS PROVISION OF THE ANTI-DEFICIENCY ACT IS WHETHER THE CONTRACT AUTHORITY OF NASA (CITED ABOVE) PROVIDES THE AUTHORIZATION FOR PROPOSED

CONTRACTUAL ARRANGEMENTS REQUIRED UNDER THE LAST PHRASE OF THIS PROVISION OF THE ANTI-DEFICIENCY ACT. AS I MENTIONED, NASA'S CONTRACT AUTHORITY IS BROAD AND WOULD SEEM TO AUTHORIZE PROPOSED CONTRACTUAL ARRANGEMENTS; ON THE OTHER HAND, THE PECULIARITY OF THE PROPOSED CONTRACTUAL ARRANGEMENTS LENDS MERIT TO THE OPPOSING ARGUMENT. THE ANSWER TO THIS QUESTION LARGELY RELYS ON HOW SPECIFIC AN AUTHORIZATION TO ENTER INTO THE CONTRACT MUST BE.

IT SHOULD BE NOTED THAT IF A PROPOSED CONTRACTUAL ARRANGEMENT IS COUCHED IN TERMS OF A DONATION BY STC TO THE UNITED STATES, THE PROVISIONS MENTIONED EARLIER WOULD BE APPLICABLE. MOREOVER, THE AUTHORITY OF NASA TO ACCEPT DONATIONS PROVIDED UNDER SECTION 203(c)(4) OF THE NATIONAL AERONAUTICS AND SPACE ACT OF 1958 DOES NOT INCLUDE AUTHORITY TO ACCEPT CONDITIONAL DONATIONS, WHICH EITHER OF THE PROPOSED ARRANGEMENTS WOULD BE.

IN SUMMARY, IT APPEARS THAT NASA, UNDER EXISTING LAW, MAY NOT ENTER INTO EITHER OF THE CONTRACTUAL ARRANGEMENTS PROPOSED BY STC. ANY MONEY RECEIVED BY NASA WOULD HAVE TO BE PAID DIRECTLY INTO THE TREASURY. FOR NASA TO GET MONEY OUT OF THE TREASURY AND TO USE THIS WITH RESPECT TO THE PROPOSED CONTRACTUAL ARRANGEMENTS, IT APPEARS THAT CONGRESS WOULD HAVE TO EVENTUALLY APPROPRIATE MONEY OR PROVIDE A MORE SPECIFIC AUTHORIZATION FOR THE PROPOSED CONTRACTUAL ARRANGEMENTS THAN IS PRESENTLY IN THE LAW.

FINALLY, MR. CHAIRMAN, I WOULD LIKE TO REQUEST THAT NASA, UPON COMPLETION OF THE STC PROPOSAL EVALUATION, BRIEF THE SUBCOMMITTEE ON THEIR RESULTS. OF COURSE, I UNDERSTAND THAT THEY WILL NOT RELEASE COMPANY PROPRIETARY DATA; HOWEVER, IT IS ESSENTIAL FOR NASA TO KEEP US INFORMED ON A PROGRAM THAT, IF APPROVED, WILL REQUIRE LEGISLATION AND, MOREOVER, OUR SUPPORT.

THANK YOU.

Mr. FLIPPO. Mr. McGrath.

Mr. MCGRATH. Thank you very much, Mr. Chairman.

I have no prepared remarks. I have been waiting for this hearing for a long time, as many on this committee know. Very frankly, I think we need a fifth orbiter. No. 2, I think the Government ought to pay for it. No. 3, I don't think that we should have private enterprise pay for it unless I can be convinced of this with sound fiscal and policy arguments.

So I am looking forward to these hearings, and I would hope that those who have been called to testify can address some of the issues and plenty of the questions that I have on this particular issue.

Mr. FLIPPO. Thank you very much.

We are pleased to have you with us today.

Our first witness is Mr. Philip E. Culbertson, Associate Deputy Administrator of NASA. He is accompanied by Major General Abrahamson, Associate Administrator, Office of Space Transportation Systems, and Dr. Stanley Weiss, Associate Administrator, Office of Space Transportation Operations.

Gentlemen, we are pleased to have you with us. Please feel free to proceed as you deem appropriate.

STATEMENT OF PHILIP E. CULBERTSON, ASSOCIATE DEPUTY ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, ACCOMPANIED BY MAJ. GEN. JAMES ABRAHAMSON, ASSOCIATE ADMINISTRATOR FOR SPACE TRANSPORTATION SYSTEMS; AND DR. STANLEY I. WEISS, ASSOCIATE ADMINISTRATOR FOR SPACE TRANSPORTATION OPERATIONS

Mr. CULBERTSON. Mr. Chairman and members of the subcommittee, it is indeed a challenging group of questions that you raise and issues that you pose, and it is a pleasure for all three of us to be here to participate in a hearing which will address those issues and, hopefully, arrive at some conclusions.

We have a single prepared statement to be given, and the three of us, then, will await your questions after I have read the statement.

We are pleased to be here today to present NASA's views on the need for, and the related considerations of procuring, one or more additional Space Shuttle orbiters to augment the flight capabilities of the approved four-orbiter fleet. Both Dr. Weiss, NASA Associate Administrator for Space Transportation Operations, and Maj. Gen. James Abrahamson, Associate Administrator for Space Transportation Systems, have joined me here today as we consider this important question.

Past discussions on the need for additional orbiters have centered on two points: The impact on meeting the payload launch demands of Government and other users—both domestic and international—when there is unscheduled orbiter downtime for repair and maintenance, or loss from service due to attrition; and the need for a sufficient level of flight capability to meet the projected traffic model for the last half of the eighties and beyond. We would be remiss if we did not note that this subcommittee has repeatedly addressed these issues over the past several years. At your direction, we are currently examining, with the Department of Defense, the

potential economies which could be realized through a block buy of additional orbiters. In addition we are presently taking steps to maintain the option for procuring a fifth orbiter by authorizing the long-lead procurement of certain items which will help bridge the gap and can also help to serve as spares for the current four-orbiter fleet. The policy issues involved in procuring additional expendable launch vehicles, additional orbiters, or otherwise providing assured capability both for firm commitments and for projected requirements continue to be examined within the administration in terms of meeting national defense launch requirements, projection of future mission traffic demand, and the need for economies, both short and long term, in providing space transportation services. In the near future, we will enter budgetary discussions within the Administration on the aspects of the issues. It is only fair to note that in the current environment of necessary constraints on Federal spending, the issues have significant budget ramifications and will be carefully considered in the overall context of national priorities.

The four orbiters presently authorized for the Space Shuttle fleet will all have been delivered by December 1984. The first orbiter, OV-102, *Columbia,* was delivered to NASA early in 1979 and has been used for the orbital flight tests. After the first operational flight in November of this year, we plan to return *Columbia* to the Palmdale plant of Rockwell's Space Transportation and Systems Group for modifications to become an operational configuration. The second flight orbiter, OV-099, *Challenger,* will be delivered in a few weeks. The third and fourth flight orbiters are scheduled to be delivered in September of next year and December 1984, respectively.

We are planning to operate the Space Shuttle fleet at least through 1987 with a maximum of four orbiters. Our current flight rate planning has the rate reaching 24 flights per year by 1988. Based on our current turnaround projections, the four-orbiter fleet will be capable of accomplishing the 24 flights per year rate and should be able to meet peak rates of close to 30 flights per year. This assumes, however, that all four orbiters are fully available and completely utilized. We are, of course, constantly examining means to decrease the turnaround time between flights to enhance the flight rate capability of the orbiter to at least eight flights per orbiter per year. The major improvements in reducing turnaround times between the orbital flight test missions indicate that the experience gained just from these three flights should give us reason to expect substantial future reductions. Therefore, we may be able to raise the flight rate to something on the order of 30 per year with four orbiters fully operational.

In our traffic model assessments, we have examined the impact of orbiter attrition and operations outages on the ability of the space transportation system to meet customer demands. We consider the effects of an extended repair or modification period for an orbiter in our planning and, even though we consider it to be extremely unlikely, the total loss of an orbiter. These assessments indicate that the severity of the impact varies depending upon the user's mission, but there would be a definite cost and schedule impact for all but the highest priority users. By way of illustration, if the four-orbiter fleet were reduced to three orbiters in 1986 due

to the loss of an orbiter, we estimate that the effective flight rate capability of the space transportation system would be reduced by about eight flights per year. Because the Space Shuttle's launch availability would be reduced—in some years by one-third of the planned flight rate—meeting the Department of Defense requirements for launch dates, assuming expendable launch vehicles were unavailable, would involve preemption of civilian missions. While the priority assigned to Department of Defense missions makes this both desirable and necessary, such a preemption would involve additional costs and program impacts to civilian users. We are aware that commercial users, in particular, will foresee this possibility and act accordingly to assure that their spacecraft are dual compatible with the Shuttle and expendable launch vehicles beyond the current transition period of the Shuttle becoming a fully operational launch system.

In facing the possibility of attrition or extensive downtime, a factor that is becoming increasingly important to consider as a practical and well understood element of the issue of augmenting the present four-orbiter fleet is the cost of procuring additional orbiters. Work on the four-orbiter fleet is nearing completion at many of our second- and third-tier manufacturers, and these vendors will shortly begin to shut down their orbiter manufacturing facilities. This is happening now to some of our critical avionics suppliers. General Abrahamson just recently visited three of our major subcontractors, and this point was emphasized by all three. We may find it necessary in the future to find and qualify new suppliers, resulting in higher costs.

As the Congress has directed, we have been investigating potential economies which could be inherent in the purchase of orbiter vehicles and their spare parts in such a manner as to enable the suppliers to build parts in the most efficient manner. This would allow the work force doing the parts fabrication, vehicle assembly, and the test and checkout process to proceed with the minimum amount of disruption.

We are also studying procurement acquisition approaches for ways to reduce costs. A block buy is one approach to hold the costs down. While block buys are normally used in large production runs where economies are achieved through fabrication of large numbers of articles and the use of repetitive builds, assembly, and checkout processes, a block-buy concept might also be applied to orbiter procurement. We are examining two options for block buy. The first would involve OV-105, in addition to a buyout of key subsystem spares. The second option would be the same as the first, with the addition of an option for Orbiter 106. We are also evaluating various contract approaches as another way of achieving economies through a heavily incentivized contract.

We have asked Rockwell to submit a preliminary cost estimate for these two options in June of this year. Concurrently, we are conducting an independent assessment to be in a position to understand better the contractor's data and also be able to formulate our own cost projections. These efforts should provide us the necessary data for the budgetary discussions within the administration.

In summary, Mr. Chairman, we are examining a full spectrum of items related to safeguards against orbiter attrition and stand-

downs, fleet size economies, and production continuity. The administration's policy deliberations are addressing these issues in the context of selecting the most appropriate and prudent approach to meeting the future launch requirements of civil and defense systems. It is clear that we need to consider most carefully the desirability of procuring additional capability for the Space Shuttle at this time, in the light of significant budget implications. Other avenues to increasing the launch capacity, such as further reducing the turnaround times, have to be taken into account. We need to determine the role of expendable launch vehicles for the future and whether they offer a reasonable means of satisfying the launch assurance requirements of the Department of Defense and certain other users, as well as meet launch traffic demands the Shuttle cannot satisfy. We are in the midst of these deliberations, Mr. Chairman, and will include their results in the budgetary negotiations within the administration.

Mr. Chairman, this concludes our prepared statement. Thank you for this opportunity to address what we believe to be a most important issue for the future. We would now be pleased to respond to questions.

[The prepared statement, plus answers to questions asked of Mr. Culbertson follow:]

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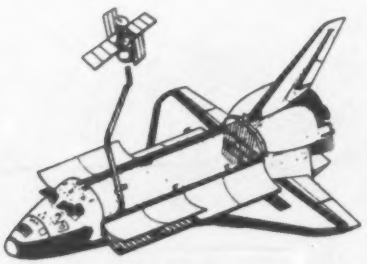
NASA
National Aeronautics and
Space Administration

Hold for Release Until
Presented by Witness
June 15, 1982

Subcommittee on Space Science and Applications
Committee on Science and Technology

House of Representatives

Statement by:
Philip E. Culbertson
Associate Deputy Administrator



97th Congress

STATEMENT

of

MR. PHILIP E. CULBERTSON

ASSOCIATE DEPUTY ADMINISTRATOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the

Subcommittee on Space Science and Applications
Committee on Science and Technology
House of Representatives

Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to present NASA's views on the need for and the related considerations of procuring one or more additional Space Shuttle orbiters to augment the flight capabilities of the approved four orbiter fleet. Both Dr. Stanley Weiss, NASA Associate Administrator for Space Transportation Operations, and Major General James Abrahamson, Associate Administrator for Space Transportation Systems, have joined me here today as we consider this important question.

Past discussions on the need for additional orbiters have centered on two points: the impact on meeting the payload launch demands of Government and other users (both domestic and international) when there is unscheduled orbiter downtime for repair and maintenance--or loss from service due to attrition; and the need for a sufficient level of flight capability to meet the projected traffic model for the last half of the 1980's and beyond. We would be remiss if we did not note that this Subcommittee has repeatedly addressed these issues over the past several years. At your direction, we are currently examining with the Department of Defense the potential economies which could be realized through a block buy of additional orbiters. In addition, we are presently taking steps to maintain the option for procuring a fifth orbiter by authorizing the long-lead procurement of certain items which will help bridge the gap and can also serve as spares for the current four orbiters. The policy issues involved in procuring additional expendable launch vehicles, additional orbiters, or otherwise providing assured launch capability both for firm commitments and for projected requirements continue to be examined within the Administration--in terms of meeting national defense launch requirements, projections of future mission traffic demand, and the need for economies (both short-term and long-term) in providing space transportation services. In the near future, we will enter budgetary discussions within the Administration on the budgetary aspects of these issues. It is only fair to note that in the current environment of necessary constraints on federal spending, the issues have significant budget ramifications and will be carefully considered in the overall context of national priorities.

The four orbiters presently authorized for the Space Shuttle fleet will all

have been delivered by December 1984. The first orbiter, OV-102 (Columbia), was delivered to NASA in early 1979 and has been used for the orbital flight tests. After the first operational flight in November 1982, we plan to return Columbia to the Palmdale plant of Rockwell's Space Transportation and Systems Group for the modifications to an operational configuration. The second flight orbiter, OV-099 (Challenger), will be delivered in a few weeks. The third and fourth flight orbiters are scheduled to be delivered in September 1983 and December 1984, respectively.

We are planning to operate the Space Shuttle fleet at least through 1987 with a maximum of four orbiters. Our current flight rate planning has the rate reaching 24 flights per year by 1988. Based on our current turnaround projections, the four orbiter fleet will be capable of accomplishing the 24 flights per year rate and should be able to meet peak rates of close to 30 flights per year. This assumes, however, that all four orbiters are fully available and completely utilized. We are, of course, constantly examining means to decrease the turnaround time between flights to enhance the flight rate capability of the orbiter to at least eight flights per orbiter per year. The major improvements in reducing turnaround times between the orbital flight test missions indicate that the experience gained just from these three flights should give us reason to expect substantial future reductions. Therefore, we may be able to raise the flight rate to something on the order of 30 per year with four orbiters.

In our traffic model assessments, we have examined the impact of orbiter attrition and operations outages on the ability of the space transportation system to meet customer requirements. We consider the effects of an extended repair or modification period for an orbiter in our planning, and--even though we consider it to be extremely unlikely--the total loss of an orbiter. These assessments indicate that the severity of the impact varies depending upon the user's mission, but there could be a definite cost and schedule impact for all but the highest priority users. By way of illustration, if the four orbiter fleet were reduced to three orbiters in 1986 due to the loss of an orbiter, we estimate that the effective flight rate capacity of the space transportation system would be reduced by about eight flights per year. Because the Space Shuttle's launch availability would be reduced--in some years by one third of the planned flight rate, meeting the Department of Defense requirements for launch dates, assuming expendable launch vehicles are unavailable, would involve preemption of civilian missions. While the priority assigned to Department of Defense missions makes this both desirable and necessary, such a preemption would involve additional costs and program impacts to civilian users. We are aware that commercial users, in particular, will foresee this possibility and act accordingly to assure that their spacecraft are dual compatible with the Shuttle and expendable launch vehicles beyond the current transition period of the Shuttle becoming a fully operational launch system.

In facing the possibility of attrition or extensive downtime, a factor that is becoming increasingly important to consider as a practical and well understood element of the issue of augmenting the present four orbiter fleet is the cost of procuring additional orbiters. Work on the four orbiter fleet is nearing completion at many of our second and third tier manufacturers and these vendors will shortly begin to shut down their orbiter manufacturing facilities. This is happening now to some of our critical avionics suppliers. General Abrahamson just recently visited three of our major

subcontractors and this point was emphasized by all three. We may find it necessary in the future to find and qualify new suppliers, resulting in higher costs.

As the Congress has directed, we have been investigating potential economies which could be inherent in the purchase of orbiter vehicles and their spare parts in such a manner as to enable the suppliers to build parts in the most efficient manner. This would allow the workforce doing the parts fabrication, vehicle assembly, and test and checkout process to proceed with the minimum amount of disruption.

We are also studying procurement acquisition approaches for ways to reduce costs. A block buy is one approach to hold the costs down. While "block buys" are normally used in large production runs where economies are achieved through fabrication of large numbers of articles and use of repetitive builds, assembly, and checkout processes, a block buy concept might also be applied to orbiter procurement. We are examining two options for a block buy:

I - OV-105 plus a buyout of key subsystem spares.
II - the same as I, with the option for OV-106.

We are also evaluating various contracting approaches as another way of achieving economies through a heavily incentivized contract.

We have asked Rockwell to submit a preliminary cost estimate for these two options in June 1982. Concurrently, we are conducting an independent assessment to be in a position to understand better the contractor's data and also to be able to formulate our own cost projections. These efforts should provide us the necessary data for the budgetary discussions within the Administration.

In summary, Mr. Chairman, we are examining a full spectrum of issues relating to safeguards against orbiter attrition and stand-downs, fleet size economics, and production continuity. The Administration's policy deliberations are addressing these issues in the context of selecting the most appropriate and prudent approach to meeting the future launch requirements of civil and defense systems. It is clear that we need to consider most carefully the desirability of procuring additional capacity for the Space Shuttle at this time in light of the significant budget implications. Other avenues to increasing the launch capacity—such as further reducing the turnaround times—have to be taken into account. We need to determine the role of expendable launch vehicles for the future, and whether they offer a reasonable means of satisfying the launch assurance requirements of the Department of Defense and certain other users as well as meet launch traffic demands the Shuttle cannot satisfy.

Mr. Chairman, this concludes our prepared statement. Thank you for this opportunity to address what we believe to be a most important issue for the future. We would now be pleased to respond to questions.

RESPONSES TO WRITTEN QUESTIONS SUBMITTED BY CONGRESSMAN FLIPPO DURING THE HEARING ON JUNE 15, 1982.

QUESTION 1:

In the original proposed manifest for the reusable Space Transportation System, how many orbiters were in the fleet? What were their functions; were they all operational, or was one an engineering model, one a spare, etc?

ANSWER 1:

At the time the new Space Transportation System was approved by the President, the plan was to have five operational Shuttle orbiters and one engineering model orbiter.

The five operational orbiters were to be used interchangeably at the Kennedy Space Center (KSC) and the Vandenberg Air Force Base (VAFB) to satisfy the civil and defense missions of the country. The plan envisioned the approximate split of three orbiters operating at KSC and two orbiters operating at VAFB.

In addition, a flight-like engineering model of the orbiter was to be maintained as a test-bed for augmentations and proposed refinements.

QUESTION 2:

Is the Agency considering possible private financing for the Space Shuttle because there are well defined requirements for the fifth orbiter, and no funding in the FY 1983 budget, or is this a plan that can be realistically implemented? In other words, does NASA need a fifth orbiter?

ANSWER 2:

As Mr. Culbertson indicated during the hearing, NASA believes that the fourth orbiter fleet should satisfy known and postulated mission requirements through 1987 or 1988. Beyond that the possibility of extended orbiter downtime or attrition would make it difficult to have a high degree of assurance that all possible future mission requirements can be satisfied by a total procurement of four orbiters. The Administration is reviewing this situation in preparing the President's FY 1984 budget.

QUESTION 3:

What is the projected STS traffic for the late 1980's? Can this be met with a four orbiter fleet, or do we need five orbiters? Do we need more than five?

(a) How large of an orbiter fleet can the NASA processing facilities handle?

(b) How many orbiters does it take to meet the 40 launches per year rate projected for FY 1991?

ANSWER 3:

Projections of STS traffic for the late 1980's have to be viewed with an understanding of the total launch capability--both U.S. and foreign launchers--and the launch demand. The planned Space Shuttle capability by the late 1980's is expected to be at least 24 missions per year. The Ariane launch vehicle family should be capable of 10-12 missions per year, which is equivalent to five or six Shuttle launches, by the 1986 time frame. Based on market projections done by a number of analyst, the total demand could be as high as 35-50 equivalent Shuttle flights. The lower figure represents an expectation that new projects currently in the design stage will be added on the continuation of currently approved space activities.

The higher figure, fifty, anticipates the continuing expansion of the communication satellite industry, the formulation of a comprehensive initial operation of a space manufacturing industry and several new opportunities in science and Earth applications motivated by the successes of early Space Shuttle flights.

Some of this demand will be satisfied in all likelihood by foreign launchers.

(a) With three mobile launcher platforms, two pads, the vehicle assembly building and two orbiter processing facilities, the KSC facilities should be able to accommodate between three and four orbiters depending on the phasing of launches.

(b) Based on our present estimates of the launch turnaround times for mature operations, it appears that at least five orbiters will be needed to achieve sustained launch rates of 40 flights per year. This is based on the expectation that a Shuttle orbiter should be capable of flying eight times per year and possibly as many as ten. However, practical considerations such as the need to reserve capacity to overcome the effects of temporary losses from service of orbiters, constraints imposed upon mission planning by high priority missions, and the launch requirements for West Coast missions have to be factored into any assessment of orbiter utilization forecasts.

QUESTION 4:

How will the payload pricing policy be affected by more orbiters in the STS fleet? Does it get cheaper to launch a payload with a larger fleet? At what point do bottlenecks occur?

ANSWER 4:

The relationship of pricing policy and more orbiters as an issue has not been addressed at this point by the Administration, and it would be premature to speculate on payload pricing policies for the post-1988 period. A larger fleet size would make payload launch costs cheaper if that meant more flights were flown each year. At present, we are resolving facility support issues as we gain experience and understand how to operate the STS; we are confident that we will be able to support 24 flights per year with our planned facilities. Beyond that launch rate, we would have to address and resolve bottlenecks as they become apparent.

QUESTION 5:

I understand that the Space Trans proposal, which you have received for private funding of a fifth orbiter is proprietary, but can you summarize for the Committee of the principal features which it contains?

ANSWER 5:

Yes, the proposal is proprietary. However, without violating the proprietary nature of the proposal it can be summarized as follows. Space Trans proposes to purchase a Shuttle orbiter in return for which they would serve as the contracting agent for the use of that orbiter and be authorized to market the STS to all commercial and foreign users. NASA would agree to operate and maintain their orbiter and to provide all launch facilities and services at a "reasonable" cost to Space Trans. NASA would agree to launch their orbiter a specified number of times per year and to provide launches for any excess commercial and foreign user traffic on NASA's four orbiters.

QUESTION 6:

How is the Space Trans concept similar to other ideas in which the private sector utilizes Government-developed technology? Is this concept similar to the creation of COMSAT or the TDRSS leasing agreement?

ANSWER 6:

The Space Trans concept in many respects represents a loan to the Government of an amount equivalent to that required to buy the fifth orbiter, to serve as the agent of the Government in marketing the use of the product which the Government has procured with that loan, to procure from the Government the services necessary to operate that product, and then to sell the total services which derive from the use of that product. Similar to other loans, it will have to be paid back, in this case through a pricing agreement that could forego future revenues to the Government. On the other hand, more normal private sector use of a Government technology uses the technology to create a new product for services which it develops, markets, and it totally responsible for, quite independent of continued contractual arrangements with the Government. In the case of COMSAT, once the corporation became an organizational entity, it used techniques, technology and concepts developed by the Government to create a commercial enterprise. That enterprise stimulated a market, procured from the private sector the equipment, both spacecraft and ground systems, necessary to support operations. The entire operational entity essentially was independent of further participation by Government beyond that which was necessary to regulate the business. In the case of TDRSS, the technology was essentially the same technology used by COMSAT and the financial arrangement was purely a loan, this time in the form of the Federal Financing Bank, with sufficient funds for the private sector to develop satellite and ground systems which the Government is then leasing. There appears to be no direct analogy between the TDRSS leasing arrangement and the concept proposed by Space Trans. A further factor making the Space Trans arrangement somewhat unique is that the attractiveness of a fifth orbiter is to a large extent dependent upon the degree to which that orbiter can be considered to add system depth

in the case of extended downtime or attrition within the remaining four orbiter fleet. In order to view it as providing that kind of depth, the Government will of necessity have to consider it on an essentially equal basis with the other four orbiters. However, it does not provide that genuine depth for the high priority missions because of the minimum guaranteed missions feature.

Thus, we do not have a case in which the private sector is developing a unique business opportunity which can be separate from deep Government involvement throughout its useful lifetime. The resulting long term commitment on the part of both Space Trans and the Government introduces factors in the economic evaluation of the proposal which are not readily apparent in other arrangements in which the private sector has an opportunity to use Government-developed technology. One final point is that for Space Trans to use its orbiter at all, it is totally dependent, at least for the foreseeable future, on continued use of Government facilities and Government contractor structures to support overall operation. That would not normally be the case in other private sector uses of Government technology.

QUESTION 7:

It is quite apparent to me that the Space Shuttle will have fairly strong competition from the Ariane, especially with Government-subsidized attractive financing. In fact, potential STS users have already "double-booked" with Ariane. My question is, do we need a company like Space Trans to effectively market the Space Shuttle?

(a) Can it offer what Arianespace can?

(b) Is there a better way to do this, e.g., a Government corporation?

ANSWER 7:

The Ariane is competitive for a number of reasons: For the period 1983-1985, the Shuttle price is cheaper than Ariane even when the Ariane financing terms are considered. However, the number of Shuttle flights projected for this period of time was not able to meet some of the customers schedule requirements. Ariane could meet some of their schedule requests.

Further, Ariane has offered an increased performance of several hundred pounds to geosynchronous orbit over that which the Shuttle and the SSUS-D can provide. This improved performance provides an opportunity for a payload user to extend orbit life time an additional 1 1/2 to 2 years which is worth millions of dollars in revenues. NASA and McDonnell Douglas are reviewing options to provide equivalent increase in performance.

In the 1986 and beyond time frame, the Shuttle should remain competitive. It is not clear what advantage Space Trans could provide.

QUESTION 8:

Given our limited knowledge at this time, what dangers are inherent in the multi-year exclusive marketing rights which would be given to Space Trans?

ANSWER 8:

Space Trans has not proposed exclusive marketing rights for the commercial and foreign use of the Shuttle but has indicated that they would expect to have the first opportunity to fly those commercial and foreign customers independent of who had brought them to the contract stage.

QUESTION 9:

Aside from your appraisal of the desirability of the Government entering into this type of arrangement, which I understand is still underway, do you believe that the arrangement which is proposed is feasible, and do you see any major technical, financial or management problems that it poses?

ANSWER 9:

This issue was discussed during the hearing; but, in summary we do not find anything in the arrangement which makes it infeasible nor do we see any major technical problems. There are however a fair number of financial and management problems which it poses that we are in the process of evaluating.

QUESTION 10:

Would you anticipate a need for new legislation in order to enter into an agreement of this type?

ANSWER 10:

We have not yet identified a specific issue which we believe needs new legislation but we are not through with this aspect of the evaluation. However, it would not surprise us at all to find that some form of legislation would be required.

QUESTION 11:

Have you determined whether or not it would be appropriate to accept this proposal without offering to evaluate competitive proposals offering similar provisions?

ANSWER 11:

Our present feeling is that it is highly likely that the Government would conclude that it should invite competing proposals before accepting any single proposal of this nature.

QUESTION 12:

Have you received any other similar proposals?

ANSWER 12:

No other proposals have been received.

QUESTION 13:

When will your evaluation of the Space Trans proposal be completed?

ANSWER 13:

We expect to complete the evaluation in August of this year.

QUESTION 14:

(a) What is the status of the orbiter production line?

(b) Are the second and third tier subcontractors still in place?

(c) When do the second and third tier subcontractors run out of work?

ANSWER 14:

(a) OV-099 (Challenger) was delivered from its Palmdale assembly facility to the Dryden Flight Research Facility (DFRF) on July 1, 1982. From there, it was transported atop the 747 carrier aircraft to KSC for its first use on STS-6. OV-103 (Discovery) is now in the initial stages of final assembly. Some major structural elements have been delivered to Palmdale including the mid-fuselage, wings and lower forward fuselage. Other major structural elements and subsystems are well along in manufacture. Over 9,000 TPS tiles are on hand and installations have already begun. OV-103 is planned for delivery in September 1983. Detail parts manufacturing and structural assembly build-ups are underway for OV-104 (Atlantis) with the mid-fuselage scheduled to be delivered in 10 months. OV-104 is the last of the approved four orbiter fleet and upon completion of its various elements and subsystems, the orbiter production facilities will begin to shutdown. OV-104 is planned for delivery in December 1984.

(b) & (c)

Most second and third tier subcontractors are still in place as they continue to complete their work on OV-104; however, some subcontractors' work force are already beginning to be taken off the program and by late this year and early next year a number of the second and third tier contractors will run out of work.

QUESTION 15:

Has NASA and the Air Force reviewed the tradeoffs between additional orbiters and continuing the use of expendable launch vehicles?

ANSWER 15:

There have been numerous studies since the Space Shuttle concept was proposed in the late 1960's that addressed the tradeoffs between space launch operations with the Shuttle, expendable launch vehicles, and combinations of Shuttle/ELVs in a mixed mode scenario. Each of these studies evaluated the Space Shuttle for various levels of annual launch capability (orbiter fleet size) and compared the economics with continued use of ELVs in accommodating the launch demand. In all cases where there were at least three orbiters in the Shuttle fleet, the

economics favored the Space Shuttle -- even for mission models containing as few as 300 flights in twelve years.

The most recent studies reconfirming these tradeoffs were done by NASA in 1977 and by the USAF in 1981. In some cases, there were individual DOD program economies by using expendable launch vehicles, such as the Scout, instead of the Shuttle; but overall, an all Space Shuttle operation provided the greatest economic benefit.

QUESTION 16:

Under Space Trans proposal who will own or have title to the fifth orbiter?

ANSWER 16:

Space Trans would propose to retain title to the fifth orbiter.

QUESTION 17:

Assume Space Trans has purchased the fifth orbiter and is operating as proposed. What happens if they fail? What rights do its creditors have against NASA or the fifth orbiter? What of the users Space Trans has contracted with to provide launch services?

ANSWER 17:

These clearly appropriate questions were not addressed in the Space Trans' proposal and would have to be resolved during negotiations.

QUESTION 18:

We understand NASA and the Air Force have completed an analysis of future launch vehicle requirements.

(a) Do you have a projection of current and future payload traffic? (Provide specific numbers on an annual basis).

(b) What estimates do you have with regard to the U.S. market which might be available to Ariane?

(c) What is the current mission model? What are your future projections? (Specific numbers on an annual basis).

ANSWER 18:

A chart "Free World Payload Projections" which displays the information requested in a, b, and c is attached.

QUESTION 19:

What would be the impact of the loss of an orbiter on the Shuttle capability? (In terms of flights per year, ability to support mission model, and impact in civil and commercial flights).

FREE WORLD PAYLOAD PROJECTIONS

U.S. LAUNCHED P/L's	FY 1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	TOTAL
INT'L COMMUNICATIONS	4	-	3	-	2	3	2	-	3	1	-	18
U.S. COM'L COMM	4	6	12	7	3	5	4	1	2	3	4	51
FOREIGN COMMUNICATIONS	7	10	14	10	7	7	10	13	12	10	10	110
FOREIGN SCIENCE	5	3	6	9	19	10	12	7	8	7	12	98
NASA & OTHER CIVIL	5	3	15	10	9	15	12	12	12	12	12	117
DEPT OF DEFENSE	16	19	21	18	17	26	23	27	29	28	20	244
TOTAL PAYLOADS	41	41	71	54	57	66	63	60	66	61	58	638
POTENTIAL FOREIGN LAUNCHES												
ARIANE P/L's	7	5	8	7	12	7	8	8	8	1	6	77
OTHER FOREIGN	2	2	5	6	8	4	7	4	4	5	4	51
TOTAL FOREIGN LAUNCHES	9	7	13	13	20	11	15	12	12	6	10	128

ANSWER 19:

The loss of an orbiter from the four orbiter fleet would reduce the capability by about 25 percent. Attendant with the loss would be an increase in the inefficiency of operating the remaining orbiters at two launch sites, a reduction in the launch assuredness due to a loss of flexibility in scheduling, inefficiencies induced because of work shift overtime to meet more demanding schedules, etc.

Our present orbiter utilization plans assume that one orbiter would be predominantly utilized for West Coast launches. The loss of one of the remaining three orbiters would leave two orbiters available to meet East Coast launch requirements. Based on the priority assigned to the launch of national security missions, the desired launch dates of the lower priority civil missions might not be met, particularly if the forecast increases in launch demand exceed the projected three-orbiter fleet launch capability of 18 to 21 flights per year. Under such circumstances, it is likely that commercial customers would have to use expendable launch vehicles (domestic or foreign) to be assured of timely launch service.

QUESTION 20:

Dr. Fletcher has said that when the Space Shuttle was being studied, there was a projected need for seven orbiters. Have you projected when orbiters six and seven would be required?

ANSWER 20:

If the demand increases in accordance with an average of the various analyses and studies that have been made, the sixth and seventh orbiters could be required in mid-1990's.

QUESTION 21:

(a) What is the status of the orbiter production base?

(b) When do the second and third tier subcontractors run out of work?

(c) To avoid a production gap when is a decision needed for a fifth orbiter?

(d) Could you elaborate on the penalties associated with the production gap?

(e) If we proceed with a fifth orbiter for delivery in 1987, when is a decision required for OV-106 and OV-107 to provide for efficient procurement?

ANSWER 21:

(a) OV-099 (Challenger) was delivered from its Palmdale assembly facility to the Dryden Flight Research Facility on July 1, 1982. From there, it was transported atop the 747 carrier aircraft to KSC for its first use on STS-6 OV-103 (Discovery) is now in the initial stages of assembly. Some major structural elements have been delivered to Palmdale

including the mid-fuselage, wings and lower forward fuselage. Other major structural elements and subsystems are well along in manufacture. Over 9,000 TPS tiles are on hand and installations have already begun. OV-103 is planned for delivery in September 1983. Detail parts manufacturing and structural assembly build-ups are underway for OV-104 (Atlantis) with the mid-fuselage scheduled to be delivered in 10 months. OV-104 is the last of the approved four orbiter fleet and upon completion its various elements and subsystems, the orbiter production facilities will begin to shutdown. OV-104 is planned for delivery in December 1984.

(b) Most second and third tier subcontractors are still in place as they continue to complete their work on OV-104; however, some subcontractors' work force is already beginning to be taken off the program and by late this year and early next year a number of second and third tier subcontractors will run out of work.

(c) A decision on a contractual go ahead for OV-105 is needed by this fall if we are to avoid a production gap which would affect the work force and manufacturing facilities of vendors who will have completed the delivery of contracted for items, including spares. This is a particular concern with regard to suppliers of structural items and piece parts. After that time, many of our vendors will be running out of work and will begin to shut down their manufacturing facilities.

(d) Penalties associated from production gaps derive from a number of areas. Tooling must be mothballed and stored if the gapping period becomes too long. Subsequently, the tooling must be removed from storage and refurbished. Loss of skills and vendors is a significant factor in gapping penalties. Work forces must be terminated as gapping occurs and must be rehired and/or retrained. Vendors shut down facilities and move on to other business, thus requiring new vendors to be found and become qualified. All of these actions result in substantial cost growth. If the decision on OV-105 is delayed one year to January 1984, and if no other actions were taken it is estimated that the gapping penalties will be approximately $200 million to $250 million. However, we are considering possible available courses of action which could be taken in 1983 to reduce this impact.

(e) To provide for the most efficient procurement of follow-on orbiters, a block buy would be the most economical approach that is, authorizing the procurement of all planned elements up front will result in the most economical approach. Assuming an OV-105 authority to proceed on January 1983 and a delivery in 1987, a go ahead for OV-106 would be required approximately one year later than the ATP for OV-105 in order to avoid gapping penalties on this vehicle.

QUESTION 22:

What block buy options are being considered?

ANSWER 22:

Two block buy options are being considered:

Option I: OV-105 plus one shipset of Orbiter sparable hardware.

Option II: Same as Option I plus OV-106.

QUESTION 23:

What budget alternatives are being considered with respect to the fifth Orbiter, e.g. a revolving fund off budget?

ANSWER 23:

The only potential budget alternative being considered with respect to OV-105 would be the private enterprise proposal of the Space Transportation Company. However, at this point the private funding of an orbiter vehicle is far from being decided upon due to complex issues involved.

QUESTION 24:

How much more does it cost a user to design spacecraft that are ELV and Shuttle compatible in order to compensate for full Shuttle schedules or DOD preemption?

ANSWER 24:

The cost to design spacecraft that are ELV and Shuttle compatible is less than five percent if the requirement is imposed when the design is initiated. However, if the design is complete and the hardware being built, is certified, then it can be a considerable cost impact. However, a dual design can impose a weight penalty and documentation preparation, both of which result in increased cost for dual compatibility spacecraft.

QUESTION 25:

Can you reiterate the future status of civil U.S. use of expendable (sic) launch vehicles?

ANSWER 25:

Four vehicle systems are presently being utilized by NASA. These are Scout, Delta, Atlas Centaur, and Atlas E/F vehicles.

The Scout is the smallest of these vehicles and is being used by DOD to launch navigation and research satellites, although NASA has one remaining scientific satellite to be launched by this system. Launches are scheduled through 1985 utilizing Scout at a rate of about three per year, primarily for DOD payloads.

Delta is NASA's workhorse - its most used launch vehicle. It is used to launch applications satellites (earth resources and weather) as well as many commercial and foreign communication satellites. It is being maintained to provide launches for five NASA missions and backup capability for the Shuttle, thus assuring users of NASA capability to

launch their satellites. Approximately six launches per year are projected from 1983 through 1985.

Atlas Centaur is currently the largest of the civilian launch vehicle family. Its main use is to lift large communications satellites into orbit. INTELSAT and the Navy fleet satellite communications system are the users scheduled for this system. Eight launches - about two per year - are planned thorugh 1985.

The Atlas is an intercontinental ballistic missile (ICBM) converted and updated for space launchings. The USAF operates this system, which is used by NASA to launch weather satellites for NOAA under a tripartite agreement. One weather satellite launch per year is planned by NOAA using Atlas E or F. The system is also used by the USAF.

Projections for expendable launch vehicles beyond 1985 are less clear, being dependent on user launch demand at that time, possible commercial operations, as well as Shuttle operational capability which will be more defined as experience is gained in Space Shuttle operations. Accordingly, NASA is planning that the Shuttle will be the primary space transportation system of the future. Expendable launch vehicle operations will be continued by the U.S. Government until the capabilities of the STS are sufficient to meet its needs and obligations.

QUESTION 26:

What are the choke points to reach 40 flights per year? How much will they cost to fix?

ANSWER 26:

Choke points to reach forty flights per year are highly dependent upon our capability to reduce the Shuttle turnaround between flights. Choke points could be the mobile launch platform, the orbiter processing facility, the VAB high bay availability or the number of available orbiters.

QUESTION 27:

Does it make sense to buy the fifth, or more of this orbiter design rather than wait and design a second generation Shuttle once experience is gained with this system?

ANSWER 27:

The orbiter vehicles are designed to meet anticipated requirements for the duration of the mission model. Changes resulting from flight experience are already being incorporated into the designs of later vehicles, particularly OV-103 and OV-104. In addition, these later vehicles will have other improvements that will increase their operational capability and OV-105 would be built to these latest designs. Design of a "second generation" vehicle would be more costly due the effects of gapping and designing and certifying a second generation design.

QUESTION 28:

There has been little discussion about what will follow the Shuttle. In the history of aircraft, the space program, long range planning gave us Mercury, Gemini, and Apollo. Since we know how to build a reflyable Space Shuttle, what happens next?

(a) Are there no plans to develop a more sophisticated spacecraft than Shuttle, perhaps returning to the idea of a manned booster element?

(b) Are there security problems inherent in mixing commercial, civilian and military payloads?

(c) Can a Shuttle on a military mission be protected?

ANSWER 28:

(a) We have studied variants of the Shuttle, concentrating on unmanned configurations to gain more payload weight and volume, to use as an adjunct for the STS. These appear feasible but do not appear to be economically justified in light of the missions identified. NASA is also doing conceptual studies of a fully reuseable manned Earth-to-orbit vehicle for possible introduction after 2000.

(b) There are no security problems mixing unclassified DOD payloads with other commercial and civilian payloads. However, we do not plan on mixing classified payloads with commercial payloads. There may be instances when classified payloads and NASA payloads are mixed. This does create an additional burden in the preparation and conduct of the mission but these can be accommodated. STS-4 is an example of this case.

(c) Data can be protected. However, meeting the physical protection needs of the Shuttle would be dependent upon the type of threat. This question should be addressed to DOD for a more explicit answer.

QUESTION 29:

Since the Air Force has priority over any other Shuttle user, does this hurt marketability of the Shuttle to commercial users?

ANSWER 29:

The Air Force itself does not have priority over any other Shuttle user. It is only when a payload required for National Security is involved that this priority may be exercised. Based on the number of dedicated missions scheduled by the Air Force, there are sufficient DOD flights spaced throughout the year that would in all probability be used for unexpected launch on demand request. Therefore, the exercise of this National Security priority is expected to be necessary on rare occasions and even if it should be exercised the impact or delay to the user "bumped" should be a minimum of several weeks to fly out on the next flight.

QUESTION 30:

Do Governmental restrictions on marketing and promotion prevent NASA from competing with such organizations as Arianespace?

ANSWER 30:

This question is discussed in question #7.

QUESTION 31:

Who would be liable for commercial customers that missed flight dates because an orbiter was lost?

ANSWER 31:

In the launch service agreements, NASA agrees to "best efforts" to meet the customer's requirement. Therefore, the commercial customer is liable for his costs incurred due to any missed flight dates because an orbiter is lost.

QUESTION 32:

If a DOD satellite were orbited, would NASA know that it was not flying something which could endanger the Shuttle?

ANSWER 32:

The DOD has the responsibility to ensure that any DOD satellite meets NASA's safety requirements for protection of the orbiter. Further, there are NASA personnel who have the proper clearances to support and do support the DOD personnel in their safety analyses.

Mr. FLIPPO. Thank you very much.

I believe we are going to have to defer questioning until we have time to go to the Chamber and cast a vote, and we shall return immediately.

Thank you.

[Recess taken.]

Mr. FLIPPO. We appreciate very much your testimony. I do have a question or two, and I really don't know how to approach it except just directly.

I would like to know what is NASA's position in regard to the fifth orbiter. Do you need one or not? [Laughter.]

Mr. CULBERTSON. Our position is that through the known and recognized firm mission assignment model that we have, which goes through 1987 and into 1988, we believe that the present four-orbiter fleet can handle the user requirements within reason. On the other hand, as we look downstream at the requirement for orbiter services and in the probable consideration that there is going to be some downtime, NASA believes that it would be very difficult to maintain continuity of flight operations if there are no more than four orbiters procured.

Mr. FLIPPO. If we have four orbiters and you lose an orbiter, would DOD flights receive priority over civilian missions?

Mr. CULBERTSON. Yes, they would. We have a specific memorandum of understanding [MOU] with the Department of Defense dealing with this issue. In that MOU, we state that if priority treatment is requested by the Department of Defense, such priority will be granted.

Mr. FLIPPO. I understand that NASA and the Air Force have completed an analysis of the future launch vehicle requirements. Do you have a projection of the current and future payload traffic that you could tell us about?

Mr. CULBERTSON. We have a projection. Dr. Weiss, do you want to describe it?

Dr. WEISS. Yes. We are actually using projections of various sorts that have been made for what I would call marketing purposes. These projections go out into the 1990's period; and, we are using them for assessments of both what our capacity requirements are—the turnaround targets we have to shoot for and the facilities that we are likely to need if we get an expansion beyond the 24 that we are set to handle now.

Mr. FLIPPO. Can you give us any specific numbers for specific years?

Dr. WEISS. I can give you a range. Let me say that we have projections that are available to us and that we have commissioned, in part, from studies made by Rockwell, by our own centers, both Johnson and Marshall, and by Battelle. As you know the AIAA did a survey about 2 years ago which also made projections, and I can give you some of the ranges that are involved.

The low end of that—and what we feel is closer to the nominal end for our projections—in 1992 or so yields a figure of up to 40. Some of the very high projections, obviously, are coincident with what we were thinking about in our more optimistic period, about 1 year ago, of reaching something in the order of 55 flights. So, we

are really seeing ranges in these projections that have been provided to us, in the early 1990's, of about 40 to 50 flights per year.

Mr. FLIPPO. Can you do 40 flights a year with four orbiters?

Dr. WEISS. If we improve the turnaround time to the maximum level we see in that time period, we could probably just manage 40 per year; that is, if you got up to 10, although that would be a very, very thin system, obviously missing 1 launch capability would cascade downwards, as would any of the attrition considerations or downtime that Mr. Culbertson referred to.

Mr. FLIPPO. Are you concerned about losing any of the U.S. market to Ariane if we retain only four orbiters?

Mr. CULBERTSON. It is clear that Ariane is going to be a keen competitor with U.S. launch services, and the answer is clearly "yes." Already we see potential users, primarily in the communications satellite world, who when left to choose between Ariane and Shuttle have, for one reason or another, elected Ariane. One of the principal reasons for that is they see the Shuttle manifest booked for the time that they want to fly.

Mr. FLIPPO. If we have interruptions in the production schedule, or gaps, are you concerned about sizable cost increases? If you are, could you give us any kind of estimates about the nature of those cost increases? Are they significant, small, large? What do you think?

General ABRAHAMSON. Sir, at this point, we only have very rough estimates. Unfortunately, these estimates come from different sources; and, therefore, I am not able to say I really have high confidence in each one. I do believe, however, that they do begin to illustrate the order of magnitude in which we are dealing. If we are able to maintain a reasonably constant work force and, thereby, come up with an orbiter on the order of the estimates that were given to this subcommittee earlier this year on the order of $1.3 billion, that would be a baseline. However, as we go ahead, as we incur a gap, and as we then try to pick up production in those outyears, we would estimate that, exclusive of any inflation, you could incur gaps and cost impacts on the order of between $200 to $250 million per year.

Mr. FLIPPO. In percentage terms of the cost of the orbiter, what are you talking about, roughly?

General ABRAHAMSON. Sir, I have to do some quick mental arithmetic, but I believe that we are talking between 20 and 25 percent.

Mr. FLIPPO. Between 20 to 25 percent more if we get production gaps.

General ABRAHAMSON. That is not a constant, sir. Some production gaps would be not such a major impact to us; others would result in losing some of our subcontractors and then having to go out and to develop a new subcontractor, which would mean requalifying that particular manufacturer.

So, I am sure we would have a mixed situation. Frankly, it is hard to project at this point, but we can project that there will clearly be some loss.

Mr. FLIPPO. Can you gentlemen tell me when a decision for a fifth orbiter must be made in order to avoid these gaps and these significant cost increases?

General ABRAHAMSON. In some respects, sir, we are already beginning to see some of these gaps develop, or at least we are beginning to see some of the subcontractors' manpower and workforce begin to be taken off the program. By the way, we are very interested in having that happen now because, of course, if they stay on for reasons other than new work, then all it would do is increase the cost of our present program. Now, at this point, those are rather minor impacts, and the one action that I have already taken in order to try to minimize that particular impact and to allow the Nation to have a better opportunity to look at the data and to make a decision—and by that I am referring to both the administration and the Congress—to authorize the additional use of spare money to try to minimize that impact.

In order to stay within what we interpret to be the intent of the Congress and, of course, the intent of the administration, we have put a limitation on that. Therefore, in any area in which we authorize moneys for those means, it also must meet the test that this would be an authorized spare for the present four-orbiter fleet. So, what I am really saying is that we are allowing a reprioritization of the timing of some of our spares purchases in order to stay within the intent of the Congress but also to meet this problem.

Mr. FLIPPO. General, could you give us the benefit of your experience in DOD with the block buy approach?

General ABRAHAMSON. Yes, sir.

As the DOD program director on the F-16, I felt, several years before the block buy approach became a talked-about method of achieving savings, that it had beneficial results in several areas: One, in saving dollars that may be allowed, but also in stabilizing the industrial base and attempting to let each company make its own production as efficient as possible. So there are both of those benefits that are available. DOD saw that in the F-16 several years ago and opened up discussions with General Dynamics. Actually, it took 2 years to develop a contract that we were satisfied with and that could meet the various tests of both administration and congressional policy. DOD expects, on that particular buy, which is now a reality since the preliminary contract has been signed—that we will get more than 10 percent savings. That is consistent with some of the other block buy approaches that the DOD has studied, some of which have been proposed.

I believe it is consistent with the kinds of savings we, NASA, would get just instituting a block buy. Now, that is separate from the issue of closing a gap or letting a gap develop.

Mr. FLIPPO. It seems to me that what I hear is that we are on a course of action with four orbiters that can marginally handle the projected usage, and if you lose one, you can reduce the capacity in the number of flights by about one-third; that the military priority would introduce further uncertainty in the civilian market; that the time for a decision is past or is fast going down the drain; that in fact we are beginning to see possible cost increases now, if we want to maintain that orbiter option; and that the position of the administration is that we can handle it.

Mr. CULBERTSON. Let me rephrase what I think the position of the administration is, if I may. [Laughter.]

The position of the administration appears to me to be very similar to yours, that we are facing a critical decision, and that decision time is upon us now. You are assuming, I think, what the answer of the administration is going to be, which I am not yet willing to do. That is the only place at which I would differ with the statement that you just made.

Mr. FLIPPO. Right, and that is what I am trying to get to. I don't want to preclude anything. What I am trying to get to is, I am asking the administration, what are you going to do about the fifth orbiter, and you are saying we can handle it with four.

Mr. CULBERTSON. I said that it is NASA's belief that we can handle it with four orbiters through 1987. In fact, that is as early as we could get a fifth orbiter if we got it underway immediately; that the issue is, therefore, in the years beyond that. NASA concurs with you completely that this is the time for the decision to be made and that we are in that era when it must be made. We, along with the rest of the administration, are studying that issue.

Mr. FLIPPO. Mr. Hollenbeck.

Mr. HOLLENBECK. Thank you, Mr. Chairman.

I would concur, Mr. Chairman, with those who feel that the time for that decision is now and that the direction of that decision on the fifth orbiter should be in the affirmative.

I am going to assume that the answer is in the affirmative, and I am also going to assume that the answer to the question of who is going to pay for it is up in the air for now.

We have today as our last witnesses representatives of the Space Transportation Co. who, as we all know, have written a proposal to NASA encompassing various items which we are not going to be able to discuss in any detail in public because of contractual and legal matters.

But I would address several general questions to you. Has NASA gone exploring for this type of proposal, and if so how far, or has this proposal been offered by this group in an unsolicited manner?

Mr. CULBERTSON. The latter is the case. It was unsolicited, and we have had no other proposals of this nature.

Mr. HOLLENBECK. Now, that is the only private proposal that you have. Could you, to the best of what you are able to do within the realms of legality, outline that proposal?

Mr. CULBERTSON. I can outline its basic principles. The proposal is one in which the funding for the orbiter would come from the Space Transportation Co. It would procure the orbiter with our assistance, but it would procure it so that it would become the property of the company rather than our property. Obviously, since the launch pad would be shared with the other orbiters, since there is no other new launch pad in the offing, the company would negotiate for their orbiter to be launched and serviced by NASA.

The company would retain the title and legal rights to the orbiter, and would propose, on a nonexclusive basis, to market the use of the space transportation system to commercial and foreign interests or commercial and foreign customers.

It would then arrange for launch services for those customers who are the product of its marketing. It would pay NASA an agreed-upon cost for the services that NASA provided, the launching, refurbishment, and maintenance. The Space Transportation

Co. would obtain its return on investment by the difference between the price it paid NASA and what it charged its customers.

In very simple terms, those are the basic principles of it.

Mr. HOLLENBECK. The DOD would have priority?

Mr. CULBERTSON. The company doesn't propose to upset any of the priorities that NASA would negotiate with anyone.

Mr. HOLLENBECK. Along that line, though, whether or not a private firm handles marketing or whether NASA is involved, do you think the fact that the Air Force would have priority over any other Shuttle user would hurt your marketability to commercial users? That troubles me.

Mr. CULBERTSON. Well, I am not sure that it makes——

Mr. HOLLENBECK. Let me follow on that. Is there any method of appeal to the Air Force evoking that priority?

Mr. CULBERTSON. Yes; they could appeal, but we have an agreement with the Air Force, as I stated earlier, and that agreement would hold whether there was a private orbiter or a private firm engaged in the marketing or not.

General ABRAHAMSON. I think it might be worthwhile to comment on the method in which we do some of the scheduling and have the discussions, sir.

The approach that we have used in the past and the approach that we are engaged in even now is that we do attempt to recognize the legitimate users in all groups for the Shuttle and to give priority and, where at all possible, to accommodate or to find a way that we can meet those launch requirements.

Now, it is only when, indeed, there is a decision that, "yes, this is a priority Air Force or Department of Defense mission, and that there is no reasonable way to accommodate everybody," that the memorandum of understanding——

Mr. HOLLENBECK. Is it a whole mission or just a part of a payload?

General ABRAHAMSON. Well, it could be either case.

Mr. HOLLENBECK. It could be either.

General ABRAHAMSON. We would then respond to a decision by the Air Force to implement that portion of the memorandum of understanding. But, I think, it is worthwhile stressing that we would be working very hard to maintain everybody's options and to try to find ways, and in many cases by a compromise of a week or so here and there, as we go downstream, that may be possible.

Mr. HOLLENBECK. Do you see any security problems inherent in mixing of civilian, military, or commercial payloads? I guess the follow-on to that is, wouldn't it be better to just simply assign some Shuttles for NASA use, some for commercial, and some for military?

General ABRAHAMSON. That is not the optimum from the standpoint of efficiency. We have discussed that with the military. In some cases, there will obviously be dedicated missions for the military when they can make an effective use of the system. We do not see how there are going to be major problems arise in many of the DOD payloads. There may be some that should enjoy the exclusive rights of their own right, and we can accommodate it.

I would like to have Dr. Weiss make a couple of remarks about the issue of preemption of commercial market satellites, too. Stan?

Dr. WEISS. First of all, the preemption is made available to the DOD for national security payloads. That means very high priority payloads, not for every DOD flight. The quantity that are involved, therefore, are not a very great number, especially as a percentage when we get down into the 1986 and beyond period.

Mr. HOLLENBECK. What percentage do you foresee? I had heard the figure 30 percent

Dr. WEISS. That percentage is about 30 to 35 percent of the total number of flights for DOD. Of those, perhaps 50 to 60 percent might be in that order. Perhaps, you can pose that question in later testimony by Mr. Aldridge.

In addition to that, we are attempting to build in some cushion to our ability to meet the model in the near years by advancing capabilities for more flights than we currently have manifested; in other words, giving ourselves some reflight capability or some catchup capability that would be afforded through additional tanks and solid rocket boosters. Within the 1984 to 1986 time period, we expect to accumulate a least a bit of a reservoir there.

On the whole, with a good, healthy, four-orbiter fleet, I believe that we will be able to accommodate even those few preemptions one might look for. In discussions to date with the DOD, they have shown every inclination to accommodate small changes in schedule and to help us work around our commercial and science needs.

Mr. FLIPPO. Mr. McGrath.

Mr. MCGRATH. Thank you, Mr. Chairman.

Phil, is it fair to say that if a decision had been made at this point for a fifth orbiter and some money toward that fifth orbiter would have been appropriated, that there would be little or no policy decision to be made about a private enterprise getting into the business of NASA and the Air Force?

Would you entertain a proposal such as Space Transportation's?

Mr. CULBERTSON. In the first place, I doubt that we would have gotten the proposal because the proposal was in recognition of the problem that the Government was facing in making up its mind about what to do. I guess I feel that the normal fiscal process within the Federal Government is pretty well established as an effective way to proceed. We have our lumps once in a while and we have our difficulties, but the present procurement process probably continues to be as good a model of the Government's funding this type of activity as any one that I could propose.

Mr. MCGRATH. In other words, you do not believe that there would have been a proposal had the decision been made, nor would you have entertained one.

Mr. CULBERTSON. I guess you had better ask the last witness if there would have been a proposal. I told you what my guess would have been, but my response has to be that certainly it is a different environment when the Government is not funding its own orbiter. I would believe that there would have been relatively little incentive to have given favorable consideration to the proposal had we had the orbiters under contract.

Mr. MCGRATH. Jim, how much of the NASA budget is dedicated toward Air Force use in the Shuttle?

General ABRAHAMSON. I am not sure that I can answer that in a direct way, sir. The most appropriate answer is to indicate that the

Shuttle is a national transportation system and a national asset. As such, it is intended to be used for all elements of the economy, and we have never tried to allocate the dollars on that basis.

What happens is that then moves to a pricing policy but, the pricing policy is one of averaging over a fairly significant period during the initial high-cost period of the Shuttle.

Mr. McGRATH. Let me ask the question in a different manner, then. How much of the Shuttle development has been advanced by the Air Force or funded by the Air Force at this point?

General ABRAHAMSON. The development of the Shuttle has been funded by NASA, consistent with the policy that was established in the early seventies. The Air Force, of course, is funding the Vandenberg ground facilities and the upper stage.

The Department of Defense has funded the unique security requirements in full. I think those are the principal areas that DOD funding has shown up in the program.

Mr. FLIPPO. Would the gentleman from New York yield?

Mr. McGRATH. Yes.

Mr. FLIPPO. The gentleman refers to an agreement in the seventies about NASA funding the development costs. Are you aware of any Air Force agreement in regard to the acquisition of Shuttles at that time? Was the Air Force committed to the acquisition of Shuttles at the time of the agreement to which you refer?

Mr. CULBERTSON. I know of no such agreement.

Let me turn around and ask the Air Force representative behind me to see if anybody wants to comment about it. Am I wrong?

Mr. ALDRIDGE. That is right.

Mr. CULBERTSON. I think they are agreeing with me.

Mr. FLIPPO. How about an understanding? Was there an understanding? You mentioned an agreement, and I am trying to put some meat on those bones. If NASA were to fund the development and acquire three orbiters and build Kennedy, what was the Air Force's understanding of the Air Force's contribution at that time?

Mr. CULBERTSON. The Air Force's understanding at the very outset was that they would fund the development of the orbiter launch capability from the Western Space and Missile Center. The upper stage, the IUS, came on a little bit later.

Mr. FLIPPO. How about the acquisition of orbiters? Was it ever an understanding that the Air Force would acquire any orbiters?

Mr. CULBERTSON. To the best of my knowledge, there was never such an understanding.

Mr. FLIPPO. Well, let me quote Dr. Seamans on March 16, 1972, in which he left little doubt about this commitment before the Senate committee in response to a question by Senator Cannon. Secretary Seamans said:

> Well, there is no question but what we would finance our own vehicles as such time as the Shuttle had been demonstrated, which I discussed with Dr. Fletcher as a "fly-before-buy" operation. We certainly must, then, pay our own way.

In further testimony before the House committee in response to a question by Chairman Teague, Dr. Seamans, then the Secretary of the Air Force, said the following:

> When the system is flying, I would anticipate a decision to use the Shuttle, and at that time it would be up to the Department of Defense to fund their own special

facilities, if required, and certainly to fund all of the boosters and shuttle equipment that would be required for DOD missions.

Mr. CULBERTSON. I don't know how to respond to that because I was not here at that time. I don't know of any agreement between NASA and the Department of Defense, but I am not about to say that the Secretary of the Air Force at that time was wrong. I will be glad to look back into the record more specifically and correct my statement if it is in error.

Mr. FLIPPO. I would hope that the gentleman would examine the record and give us the benefit of his views as to whether or not that was the agreement as testified before the House and Senate committees.

Mr. CULBERTSON. We will specifically go back to that.

Mr. FLIPPO. I appreciate the gentleman's yielding, but I thought that is the point the gentleman was trying to demonstrate, so I thought I would put that in.

Mr. MCGRATH. You have demonstrated it better than I could have. [Laughter.]

Phil, how much of the redesign work of the STS was at the suggestion of the Air Force?

Mr. CULBERTSON. The redesign work?

Mr. McGrath. The redesigning and designing of the entire Shuttle.

Mr. CULBERTSON. The basic specifications were written around our joint requirements, and the requirements were heavily influenced by the Department of Defense. I cannot give you a percentage, but there were a number of the specific parameters which were established by Department of Defense requirements. I would say that those parameters were a very major influence on the overall performance of the system.

Mr. MCGRATH. Does the Air Force pay the same amount of money to NASA as commercial customers for the use of launch facilities?

Mr. CULBERTSON. Stan, would you respond to that question?

Dr. WEISS. The Air Force reimbursement is based on the same elements as commercial and foreign users. However, because of two factors, theirs is a somewhat lesser charge. The decrease is because of the exchange of services between the Air Force and ourselves with respect to NASA launches at Vandenberg, when it becomes operational, and Air Force launches at Kennedy, as well as their investment in the Vandenberg facility.

In addition, for instance, for launches at Vandenberg, they would be supplying the propellants; so, we do not include that in their charges. We include all the materials and services that are used by the Air Force for their specific flights; namely, the expendables usage such as the external tanks, the refurbishment of the solid rocket boosters, the additional services, and personnel services that are not exchanged. In all, one can factor the Air Force reimbursement directly from the charges to commercial users.

Mr. MCGRATH. If a Shuttle is lost on a military mission, who is responsible for the cost of replacement?

Mr. CULBERTSON. We have not faced that question because we have not yet provided a continuing program for the replacement in the event of attrition. It continues to be NASA's position, however,

that procurement for the orbiter fleet is, overall, a NASA responsibility.

Mr. MCGRATH. Either for your own use or commercial use or military use?

Mr. CULBERTSON. That is right.

Mr. MCGRATH. Have you asked for any money for a fifth orbiter in the fiscal year 1983–84 budget?

Mr. CULBERTSON. We asked for——

Mr. MCGRATH. Production money.

Mr. CULBERTSON. We requested, in our original fiscal year 1983 position with OMB, $90 million for the fifth orbiter.

Mr. MCGRATH. That represents less than 10 percent of what an orbiter would cost.

Mr. CULBERTSON. Fundamentally, it would have represented a go-ahead. It would have been the first year for the production. In fiscal year 1981, to review the history, Congress authorized the use of $5 million for protecting the option for the fifth orbiter. In the original fiscal year 1982 budget, there was $25 million for long leadtime items for the fifth orbiter, and this was subsequently cut. Our request for fiscal year 1983 was the $90 million, and, of course, we have not submitted the fiscal year 1984 request yet.

Mr. MCGRATH. We are really down to a double-park situation now as to a decision necessary in order to continue the production of the Shuttle with the subcontractors and the contractors?

Mr. CULBERTSON. I think General Abrahamson put it correctly. There is no point at which you literally fall off the cliff, but it is becoming increasingly expensive to proceed.

Mr. MCGRATH. Now, in light of all of the questions I have asked and the questions that the chairman has asked regarding Air Force participation for the purchase of a fifth orbiter and the entire STS system, is it NASA's position that the Air Force should pay for the fifth orbiter?

Mr. CULBERTSON. The decision on the part of the administration is yet to be made. The decision was made for fiscal year 1983 for the budget request that was submitted in the first part of this year. The decision for fiscal year 1984 is yet to be made, including the decision as to who might do the funding, if there is to be funding.

Mr. MCGRATH. In spite of all of the testimony for the need for a fifth orbiter, you are sitting there and telling me that the decision has not yet been made.

Mr. CULBERTSON. The decision was made for fiscal year 1983, and the next decision to be made is the fiscal year 1984 decision.

Mr. MCGRATH. Let me ask you another question. How many orbiters is it going to take in order to reach the 1991 objective of having 40 launches per year? Can you do it with four?

Mr. CULBERTSON. Sure. As Dr. Weiss said, if there is no attrition and no significant downtime, we believe we can launch 40 flights in 1991. Is that a fair reassessment of what you said, Stan?

Dr. WEISS. Yes, so long as we could meet our very optimistic turnaround goals. So, obviously, the marginality is clear.

Mr. MCGRATH. I have no further questions at this time.

Mr. FLIPPO. Mr. Winn.

Mr. WINN. Thank you, Mr. Chairman.

I was going to bypass my time because I do see that it is running late and I do want to hear from the other witnesses, and I am sure the subcommittee does, too, and I thank you for recognizing me.

Isn't it true, Phil, that at this stage of the game, NASA is really trying to get the Air Force to some kind of an agreement to pay more than they have on the previous Shuttles for the fifth orbiter? Aren't we in a sparring contest right about now along with OMB playing a very important part in that decision?

Mr. CULBERTSON. I was wrong in the last fundamental question that I answered. I do not know what might be going on in some corners of the DOD and NASA, and I do not know of any formal approach that we have made with the Department of Defense to suggest that they ought to buy the fifth orbiter.

Mr. WINN. Now, I did not say that they ought to buy it. I don't think, under the budgeting process and under the OMB requirements and under the fact that both agencies have to go to OMB to get the approval to make a deal of this type, I don't think that the Air Force or NASA is going to be the sole purchaser or the only one to pay for a fifth orbiter. I think, in my opinion, it is going to be a joint effort.

It is obvious that OMB is going to have to go along with whatever decision is made, and this may not be an easy decision for them or for NASA or for the Department of Defense, depending on the percentage that each agency picks up.

Mr. CULBERTSON. I agree that this is true. If it were that a fifth orbiter provided significant economies in one direction or another for either NASA or the Department of Defense, one could say some of those funds might be diverted to assist in the production costs of the fifth orbiter. But that has not been a subject of negotiation.

Mr. WINN. Is it true that some people at NASA feel that they ought to put more pressure on the Air Force to pick up a higher percentage of the fifth orbiter because they think, under the present philosophy and under the present direction and under the present administration, that the Department of Defense is going to have an easier time with their budget than NASA is going to have with its budget?

Mr. CULBERTSON. With 21,000 employees, it is hard for me to say that nobody in NASA is thinking that way, sir.

I do not really know how to respond to that question. We are looking both at the issues and how funding might be handled, and I would have to assume that somewhere some of those kinds of conversations and urging are taking place. However, I do not know of any formal approach to the question.

Mr. WINN. I do not think there are any formal approaches at the present time.

Down through the years, and most recently the figure that I have heard, and no one has mentioned a percentage figure—Mr. McGrath asked and no one at the table answered—General, he asked the question of you, and I did not hear a positive answer, but I have heard the figure of 17 or 18 percent as the Air Force's percentage of participation in the Shuttle. You did not give any percentage, and you cannot say there is not some percentage.

General ABRAHAMSON. Oh, no. I believe the context in which I answered the question and in which I understood the question to

be was: "What percentage of investment was the Air Force making in the NASA portion of the program?" If one looks at the investment that the Air Force has made in the development of the Western Space and Missile Center, the investment that they are continuing to make in the development of the inertial upper stage and in the investment that they will make in some of the tracking facilities and some of those items, that adds up to an appreciable amount. I think it is substantially over $5 billion.

In that sense, if one looks at the national contribution of the two agencies, I believe it is something like a contribution on the order of two-thirds on the part of NASA and one-third on the part of the Air Force into the national space transportation system.

Mr. WINN. All right. I think that was the direction in which Mr. McGrath was aiming his question, and my percentages, then, are not too far off.

Mr. CULBERTSON. Perhaps, when you get the Air Force testimony you may ask a similar question. They may have more specific numbers in their evaluation.

Mr. WINN. I would be glad to ask them.

Thank you, Mr. Chairman.

Mr. FLIPPO. Thank you.

Mr. Lowery.

Mr. LOWERY. Thank you, Mr. Chairman.

I will be brief with my questions.

If a Shuttle is lost, how will it affect both future launch dates and various contracts and commitments we have?

Mr. CULBERTSON. How would it affect the future launch dates?

Mr. LOWERY. Launch schedules. How are we going to factor that in? Is there a backup program if we lose one of the birds?

Mr. CULBERTSON. It depends on when such a loss were to occur. If the Shuttle is lost, there is likely to be a period of time that we try to understand why it was lost before we fly anything more. So, there would undoubtedly be some period of downtime while we analyze the problem, and there might be a downtime beyond that while we made a change. The problem would be similar to what happens in an aircraft fleet when there is a problem.

Since the Shuttle fleet does not have the capability to support the total requirement now, we and the Department of Defense are both carrying expendable launch vehicles and will through at least 1986, I guess, to protect against that specific problem. DOD can address that issue later on. Beyond that, the problem would be similar to that which we would encounter if there were a problem causing us to delay a launch by 1 month or 2 months. Each time a Shuttle flies, there will be another Shuttle flight planned from the same launch pad before the first Shuttle flies again—that is, once we get fully operational.

I may not have addressed the question that you are driving at, but it is the only way I know how to answer it.

Mr. LOWERY. No, you have. I am looking for backup. I know we are phasing into a new area; it is a rather exciting time. I am exploring whether NASA and the Department of Defense have some contingency plans.

Also, let's say, due to national security, the Air Force or NASA, for that matter, needs to bump a scheduled commercial customer.

What are we doing, or what are we anticipating, so that we are not driving business into the arms of ESA?

Mr. CULBERTSON. We have talked about that a little bit, but we are trying to provide some margin in the total launch and flight schedules so that a reasonable delay or preemption by the Department of Defense will not cause a ripple in the flight plan that continues for a long period of time.

Just as—you are familiar with built-in holds in our countdown which we put in specifically in case we get some kind of a problem and we can make it up during that period—we are trying to build some unassigned missions into the flight plan, and we will continue to do so to provide the kind of margin that you are asking about.

This would at least confine the problem to a finite period of time. There are other things that we can do. For instance, we are not now, for the operational years, planning an around-the-clock operation at the cape. We are cutting it back to two shifts and either 5 or 6 days a week. We can make up some time to try to get an extra launch in by a high assignment of overtime. We have done that in the past with expendable launch vehicles when we had some kind of a problem. It is a little more expensive to do it that way, but it sometimes is prudent and less costly to provide some margin.

Mr. LOWERY. You are not overcommitting, then, in terms of schedule.

Mr. CULBERTSON. We are tight.

Mr. LOWERY. We have got a number of F-14's at Miramar Naval Air Station—I am sorry to say that in front of the Air Force here—in San Diego that are on the ground, and I imagine a number of F-15's as well at various bases, simply because we don't have adequate parts to get the aircraft up.

What is being done in terms of parts for Shuttles over the long term, particularly in keeping those production lines open at Rockwell and elsewhere with your subcontractors?

General ABRAHAMSON. Sir, there are actually three categories of activities. The first and the most important one is to make intelligent spares purchases, and we are, in this last year, increasing our rate of spares purchases rather substantially. I indicated earlier that we will accept a change in priority for those spares so that in some cases we will purchase things that we might not have needed as early as we presently are buying them in order to maintain a production line and a capability so that we don't lose it.

Mr. LOWERY. But you are anticipating plenty of leadtime for items and have backup so the Shuttle is not down due to not having the proper filter or whatever?

General ABRAHAMSON. Well, no. As I say, we are really building up in our spares purchases, particularly this year. Although there were some in the last couple of years as well, those were minimal amounts that were invested in the program at that point. The reason was the basic philosophy of the early years of the Shuttle was, so long as we had a production line and additional orbiters coming down that production line, we could cannibalize, and we did this in several of our launches. We have cannibalized parts, special hinges, and assemblies in the tail. We took them off the OV-099 vehicle in order to make our last launch, and we have done that rather continually where that is necessary.

Now, a program can afford some of that disruption and can afford to do that so long as there is a continuing production line, but as you see the end of those production lines, then you must face up to a buyout of spares. We are just now beginning to face that particular issue, you must begin to look into long-term arrangements for spares and sustaining engineering, and we are now beginning that effort. That will be defined over the next several years. Again, that will vary depending on the final national decision on the size of the fleet.

Mr. LOWERY. A final question, Mr. Chairman. I will make it very quick. If it is an Air Force mission, who has ultimate control, NASA or the Air Force? For example, if a decision was made to abort, who would make that decision, and could it be overruled?

General ABRAHAMSON. Well, it is a complex issue in this sense. Clearly, if it involved the safety of the orbiter and the people in general, that is a NASA decision. The Air Force or the Department of Defense would maintain the priority for the payload, if it were a DOD payload. There would be consultation between both of these in order to try to come up with a right and proper decision.

Mr. LOWERY. Will NASA be aware of what the payloads are?

General ABRAHAMSON. Certain people in NASA would be fully aware of what the payloads are, yes, sir.

Mr. LOWERY. Thank you.

Thank you, Mr. Chairman.

Mr. FLIPPO. Mr. Hollenbeck, do you have a final question?

Mr. HOLLENBECK. Yes. Mr. Chairman, in my opening remarks, I alluded to the concerns that I have heard from many people over the traditional openness of our civilian space program, and I think that is what many of our questions were aimed at today. We see stories that the Soviet Union is charging that the Shuttle has the potential of being an important strategic weapon, that on June 27 a military payload will be going up. I heard someone say that the way we are running it now, it is sort of like having Pan Am or TWA fly military surveillance missions.

Don't you think that this increased influence and military use threatens the openness of our civilian space program?

Mr. CULBERTSON. Both General Abrahamson and I would like to comment on this issue.

General ABRAHAMSON. Frankly, I think that the concern that has been stated in some newspapers has been overstated. It is a legitimate concern, however.

First, I would like to answer that as a military program manager who has been involved in classified programs, I have always felt that it would be a great benefit to be able to run a military program with the same openness that NASA has been able to run its program in the past. In the end, I believe it is easier because we can tell the story and the program will rise or fall on its merits. In that way the Nation, the administration, and the Congress, people who must make decisions on the program, will be in a better position to make those decisions, as well as the people who must in the end support them.

So in the end, I think that is the most desirable. Unfortunately, in some circumstances, we must maintain security just because of the military significance of what is going on.

Just yesterday, I conducted the flight readiness review for our next launch. We had both NASA personnel and Air Force personnel on an unsolicited basis stand up and say that they were very pleased with this particular launch and the security aspects of it and that they felt that we had learned a great deal by going through the security exercise; in addition to that, they felt that we had maintained to the maximum extent possible and practical what really are the legitimate concerns and aims of both agencies.

As the Associate Administrator for NASA responsible for the program, it is my clear objective to preserve the basic intent and the spirit of an open program by which NASA has conducted their programs in the past. With military payloads, there will be some compromise. In my opinion, and as a military officer, I think that those will be minimal. Now, I do believe that there will be some news people who will try to overstate the case to try to use that incorrectly, but I feel we will be able to maintain a legitimate compromise.

Mr. CULBERTSON. Let me add just one word from a slightly different perspective. Just as Abe goes back to his experience within the Department of Defense, I would like to go back to my experience as a contractor. I was the chief project engineer for the Atlas launch vehicle at General Dynamics in San Diego.

People tend to forget that the Atlas, which NASA has used so much, was a derivative of a military vehicle and that the Delta was a derivative of the Thor, both of which were ballistic missiles.

Atlases were launched alternatively for both military and civilian payloads from a single pad at the cape. As a matter of fact, with my responsibilities for the Atlas on John Glenn's flight, I recall that it was an Air Force officer to whom, as a contractor, I reported. NASA worked through the Air Force to procure the Atlas both contractually and technically.

Both NASA and the Air Force used Vandenberg Air Force Base, continue to use it for southern launches. I think that the Shuttle gives a unique visibility to the fact that we are working together. In fact it does not change any of the principles that we have worked with—that have governed the working relationships between the civil and military world since the space program began.

Mr. FLIPPO. Gentlemen, thank you very much for your testimony. We appreciate your patience in this important matter as well.

Thank you very much for being with us.

Our next witnesses will be Hon. Edward C. Aldridge, the Under Secretary of the Air Force, Department of the Air Force. He is accompanied by Dr. Charles Cook, who is the Deputy Assistant Secretary of Space Plans and Policy, and Brig. Gen. Bernard Randolph.

Gentlemen, we are pleased to have you. We apologize for the lateness of the hour. We would ask you to summarize your statements. We will, of course, insert the full statement in the record.

Please proceed as you deem appropriate.

STATEMENT OF HON. EDWARD C. ALDRIDGE, UNDER SECRETARY OF THE AIR FORCE, DEPARTMENT OF THE AIR FORCE, ACCOMPANIED BY DR. CHARLES W. COOK, DEPUTY ASSISTANT SECRETARY, SPACE PLANS AND POLICY; AND BRIG. GEN. BERNARD P. RANDOLPH, DIRECTOR, SPACE SYSTEMS AND COMMAND, CONTROL AND COMMUNICATIONS

Mr. ALDRIDGE. Thank you, Mr. Chairman.

You have already introduced Dr. Cook and General Randolph.

I have a prepared text which I will ask you to insert for the record, but I would like to just briefly summarize the major points. I know you are anxious, as I am, to get on with many of the questions that came up earlier.

The Air Force is very encouraged by the success of the first three Shuttle development flights and is looking forward to the next flight on June 27 which will carry the first DOD payload. Based on demonstrated performance and anticipated transition to an operational capability, the Air Force fully supports NASA's procurement of a fifth orbiter.

We believe a five-orbiter fleet is required to support our national commitment to the Shuttle and support the launch requirements of a multiplicity of users, of which the Air Force is one.

While the Department of Defense can satisfy its own requirements with four-orbiter fleet based upon the established priorities, we believe the risks in such a program are unacceptable to the Nation due to the possibility of orbiter attrition or the possibility and problems with orbiter turnaround to meet our mission requirements.

In addition, we have another series of concerns. One is that only two orbiters will have sufficient performance to meet some of our critical DOD missions. The leadtime for replacement of an orbiter is about 5 years from a decision to do so, provided the production capability exists.

The engineering team that might be required to make design changes to the four orbiters, if they are necessary, will begin to disappear prematurely unless a fifth orbiter is in fact procured.

Last, until we obtain the additional operational data, it will be difficult to determine the ultimate orbiter fleet size required. Five or even more orbiters may be necessary to meet our mission requirements.

Mr. Chairman, we believe the Shuttle program is an essential national program, the cost of which should be borne by the Nation. It really should not depend on which agency procures it. It should be a national program.

While we believe it is important to utilize the Shuttle for civil and commercial purposes, we cannot endorse the commercial funding for orbiter procurement at this time. We believe that there are legal problems, liability uncertainties, unfair competition issues, and even security concerns that are yet to be evaluated and resolved. We are working on those problems now, but we have not yet seen adequate solutions from the Department of Defense viewpoint.

Mr. Chairman, the Air Force urges the Congress to support NASA's requirement and procurement of the fifth orbiter.

Sir, I will be glad to answer any questions now.

[The prepared statement plus answers to questions asked of Mr. Aldridge follow:]

DEPARTMENT OF THE AIR FORCE

STATEMENT OF

HONORABLE EDWARD C. ALDRIDGE

UNDER SECRETARY OF THE AIR FORCE

BEFORE THE

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

CONCERNING

THE NEED FOR ADDITIONAL SPACE SHUTTLE ORBITERS

JUNE 15, 1982

NOT FOR PUBLICATION UNTIL RELEASED
BY THE HOUSE SUBCOMMITTEE ON SPACE
SCIENCE & APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY

Mr. Chairman, it is a pleasure to appear before this Committee to present the Air Force views on the need for additional Space Shuttle Orbiters. I am accompanied today by Dr Charlie Cook, the Deputy Assistant Secretary of the Air Force for Space Plans and Policy; and by Brigadier General Bernard Randolph, the Director of Space Systems and Command, Control and Communications in Headquarters U S Air Force.

Mr. Chairman, the three flights of the Columbia are more than a historic demonstration of the reuse of a space vehicle. They are the first steps toward a routine, repeatable and increasingly frequent use of space. We all are intensely proud of NASA's achievements in the design and development of the Space Shuttle. That task is, however, not complete -- the Shuttle has worked very well in a test program; we now need to assure that it grows into a dependable and efficient operational system.

The Shuttle, from its inception in the early 70's, has been termed and designed as a "National" system -- intended to serve a host of users as the common launch vehicle for all. The Shuttle system was, therefore, sized to meet the estimates of the "National" launch requirement. Obviously, both the estimate of those "National" launch requirements and the Shuttle's ability to support them have changed with time. As the System Operator NASA is the ultimate U.S. Government authority on the demand for Shuttle launches and the Shuttle capability to supply that service. The DOD does, however, have a key role to play as both a user and as the operator of one of the Shuttle launch sites, Vandenberg AFB.

It is as the representative of a major user, the defense space program, that I wish to address the Committee's question about additional Orbiters.

In its simplest sense the question of additional Orbiters is one of a basic supply and demand problem. What is the "National" launch requirement "demand" and how can the Shuttle "supply" meet that demand. If the "supply" of launches is less than the "demand", should more Orbiters be procured to bring supply and demand back into balance? Unfortunately, the problem is a lot more complex.

The "demand" for Shuttle launches is jointly determined by NASA and DOD. DOD develops the estimated DOD and DOD-sponsored launch requirements, such as NATO. These are provided to NASA for incorporation into the National Mission Model. NASA is responsible for the determination of the launch demand for all civil Shuttle traffic to include U.S. Government non-defense payloads, U.S. commercial satellites, and foreign civil users. The majority of the Shuttle mission model requirement will be for civil use.

The DOD requirements are currently for 118 launches of the total 312 Shuttle launches projected by NASA through 1994.

These DOD requirements are formally re-evaluated twice a year based upon the program projections contained in the President's Budget. The review process provides a 12 year projection of DOD launch requirements based, ultimately, on approved budget levels. There is, however, a separate set of actions which provide a much more definitive estimate of near term (three to four year) requirements. Like any other user, the DOD is required to submit formal launch requests to NASA to request specific launch support. The Deputy Commander for Space Operations, Air Force Space Division, is the central clearinghouse for all requests for launches of DOD payloads. He is charged with the responsibility

of maintaining the accuracy and currency of the launch requests and for assuring the consistency between the DOD requirements as projected in the Mission Model and as submitted with the launch requests. He works closely with NASA to assure that NASA has the latest information on our requirements.

"Demand" includes much more than a numerical quantity of launches per year. Demand also includes the obligation to satisfy unique payload and schedule requirements. For both DOD and civil users, launch requirements can be generally grouped into three classes.

- The first class consists of replenishment launches for existing on-orbit assets. These are normally characterized by high priority, urgent launches driven by the failure of an on-orbit spacecraft.

- The second class are launches to establish a new capability. These are characterized by reasonably firm launch requirements accomodated by advance scheduling.

- Thirdly, we have launches of one-of-a-kind research and development spacecraft which are, comparatively, low priority launches with flexible launch schedules.

Both the civil and DOD mission models are, therefore, an amalgam of quite different requirements. Each launch must, therefore, be considered separately and uniquely based upon the characteristics of the payload program it supports.

If there is one significant difference between civil and defense payloads, it is physical size. Defense payloads in many cases are large enough to stress the capability of the Shuttle to its design limits. Civil payloads are generally smaller and approach the Shuttle performance limits only when combined into multiple payload cargoes. It is, however, these multiple payload cargoes which provide the basis for the economic competitiveness of the Shuttle compared to alternatives like the French booster, Ariane.

With that background on how we determine the DOD "demand" for launches, let me turn to the "supply" side. NASA is the System Operator of the Shuttle and, therefore, responsible for determining the capability of the system as it matures. We are closely involved with NASA in their work on fleet capacity.

The work to date shows a progressively increasing fleet capacity indicating both the incremental addition of more Orbiters and the growing skill and confidence of the launch and control teams in the Shuttle turnaround process.

All of the analyses depend heavily upon the assumptions concerning the investment to improve the turnaround process. Depending upon the assumptions made, the capability at maturity will reach 24 to 40 launches per year or 6 to 10 launches per Orbiter per year for a four Orbiter fleet. One near-term constraint is the External Tank production capacity. Another critical factor in reaching the 10 launches per Orbiter per year (and, therefore, a critical factor in making optimum use of additional Orbiters) is the capability to efficiently process the Space Shuttle Vehicle for each launch. The analysis indicates that added facilities -- such as additional Mobile Launch Platforms, Solid Rocket Booster processing cells, and Vehicle Assembly Building processing cells at Kennedy Space Center -- are needed to make optimal use of the available Orbiter assets.

The adequacy of the logistics support is yet to be demonstrated. It too will have a significant effect on our ability to generate high flight rates.

Further, we are still studying the capability of Johnson Space Center to process the flight planning, training, and control requirements for 24-40 flights per year. The problem will be compounded by the requirements imposed for security for some portion of those flights. Additional capability may be required at JSC, although the advent of the Consolidated Space Operations Center will provide significant additional capability in the late 80's. It is only when the system removes these choke points that the launch rate will rise toward the 40 per year. Additional Orbiters will not add to our launch capability unless these mission control chokepoints are also rectified. The message is that investment is required in turnaround improvements and control capability as well as in additional Orbiters. We support NASA investment in all of these areas.

There are many other considerations which must also be included in the Orbiter procurement decision. For example,

- Regardless of the assumptions made on turnaround, the Shuttle system cannot tolerate Orbiter attrition or extended down time for overhaul or repair without significant operational impact.

- The four to six year delay to replace an Orbiter would severely disrupt both the military and civil space programs.

- Only two of the four Orbiters are the lightweight, fully capable Orbiters required for certain missions.

- Additional operational experience will certainly indicate design changes which could result in improved capability.

- While not now estimated to be a near term problem, Orbiter wear out is an eventual certainty either from structural fatigue or from technological obsolescence.

- And, finally, the Orbiter production team is a valuable and unique asset that will disappear if the line stops at four Orbiters

When these considerations are factored into the decision, we believe that the Orbiter production line should be maintained and that additional Orbiters should be procured. Specifically, we support the procurement of a fifth Orbiter and the provision for additional procurements, as needed. Production of a fifth Orbiter will:

- Significantly augment the capability of the four Orbiter fleet.

- Provide a continued production capability until the ultimate fleet size is determined.

- Provide a sustained logistics support production base.

That position is not based upon the National traffic requirement which can be better articulated by NASA. It is based upon the belief that the Nation, if it is to totally commit both essential defense and civil missions to the Shuttle, must retain some confidence in the continued operational capability of the system. That confidence requires that the system be able to tolerate some level of attrition without undue disruption. It also requires that the early operational period be allowed to progress without foreclosing on the opportunity to exploit what we learn through a better Orbiter.

That leads to the question of how we should proceed on Orbiter Procurement and, additionally, the potential for commercial funding. Commercial funding proposals appear innovative and it is encouraging to observe interest on the part of U.S. business to participate in some of the Nation's space efforts. It is in the long-range interest of the U.S. to encourage participation in space activities by private interests. Since procurement of a fifth Orbiter would be in the best National interest, it is appropriate to consider commercial proposals which might take some of the burden from the taxpayer.

However, there are some aspects of the proposals that will present difficulties for NASA and the Air Force, as might be expected with a new and innovative ideas There are potential liability and competitive problems. There may also be issues involved that will require legislative changes to accommodate private space ventures.

While we are interested in the idea of commercial procurement of an Orbiter, we cannot give an unqualified endorsement because we do not yet fully understand

the advantages and limitations that such a concept would impose. In the meantime, we would ask that Congress maintain the funding of NASA for a fifth Orbiter as a means of insuring the availability of that vehicle.

Mr. Chairman, thank you for the opportunity to present our views on Orbiter procurement. We will be happy to answer the Committee's questions.

Question 1: Can the DOD utilize a five orbiter fleet, or are four Space Shuttles sufficient? Will DOD shuttle overflow be flown on expendable launch vehicles? Which one's?

Answer: The DOD Shuttle traffic requirement through the early 1990's is eight growing to fifteen Shuttle launches per year. This launch rate depends upon assumptions in mission requirements and success in combining individual DOD payloads into mixed payload launches. A four Orbiter fleet during that same period will generate 24 to 40 launches per year. The DOD will, therefore, use 20% to 63% of the Orbiter fleet capacity depending upon the assumptions used. The DOD has priority on the Shuttle for its payloads; thus, the four Orbiter fleet is sufficient for DOD use.

DOD support of additional Orbiters is derived from the belief that the Nation needs an adequate Orbiter fleet to support the entire Shuttle traffic model (DOD and civil). "Adequate" is not, however, limited simply to the requirement for a number of flights per year. The Orbiter fleet must be able to withstand attrition and must account, eventually, for Orbiter wearout. We have just begun to operate the Orbiter and are still gathering the data required to estimate the capability of the Shuttle to provide sustained support of the National launch requirement. It seems prudent, therefore, to continue Orbiter production, through NASA, especially given the long lead time to produce Orbiters (four to six years).

Given our priority and the size of our requirement compared to the four Orbiter capability, there will be no DOD Shuttle overflow to be flown on expendable launch vehicles. We maintain a backup expendable launch vehicle capability (currently three Titans) to provide for high priority launch capability during short term Shuttle outages. We plan to phase out the Titan backup by 1985 and will launch the last of our expendable launch vehicles (Atlas) by 1989.

Since it is civil flights which may not be flown on Shuttle (due to DOD priority), NASA continues to offer Delta and Atlas Centaur as expendable launch vehicle options to the Shuttle for civil users.

Question 2: Some have proposed that eventually the Space Transportation System will be turned over to a private operator, or operators.

(a) Doesn't DOD now use many private sector operators (of ships and planes) for transportation? How do you interface with these contractors?

(b) Would DOD be willing to purchase launch services from a private operator?

Answer: a) Yes. Transportation requirements are consolidated by the single managers for the various types of carriers (land, sea, air). The single manager then determines what type of transportation capability will be used: organic DOD capability, US Government, US commercial carrier, or foreign carrier. The type chosen is governed by factors such as defense mission and operational requirements, capability, availability and cost.

b) Yes. The DOD currently purchases its launch capability from private commercial concerns. There is no launch system in use by DOD (expendable launch vehicles or Shuttle) which does not depend upon civil contractors for production, operation and maintenance of critical elements of the capability. There is no organic DOD space launch capability. The DOD (or NASA) does however, take title to all of the flight hardware used for launches. In all cases the majority (95% or more) of the manpower involved in DOD launches is contractor supplied.

Question 3: If DOD were to invest in a future fleet of Shuttle orbiters, what would bind them to any agreement struck between NASA and STC? More specifically, could DOD ignore such an agreement (NASA and STC) and go into competition with the firm or make a similar arrangement with another private firm?

Answer: The DOD agreement with NASA states that the DOD will represent all DOD and DOD sponsored payloads. NASA will represent all civil users (civil US government, commercial, and foreign civil payloads). Our understanding of the Space Transportation Company (SpaceTran) proposal is that they would become the agent for commercial and foreign civil users of the fifth Orbiter (a portion of the total civil users). Any such agreement between NASA and SpaceTran would, therefore, affect only those payloads which we have already agreed were NASA's responsibility to represent. We do not intend to broker or otherwise represent civil users regardless of the success or merit of the SpaceTran proposal.

Question 4: Are there similarities in how DOD will interface with the proposed future Shuttle Processing Contractor at Kennedy Space Center and Space Tran?

Answer: The Shuttle Processing Contractor (SPC) is a proposal to consolidate the multitude of contractors operating Kennedy into one contract and withdraw the traditionally intensive and intrusive NASA contract management back to a contractor oversight role typically used by DOD. DOD will not "interface" directly with the SPC. We are a user of Kennedy capability and will work through the NASA management. We are, however, interested in the progress of the SPC toward reducing O&M costs at Kennedy. In so far as we can, we will operate Vandenberg identically to Kennedy. Cost savings measures at Kennedy will be closely investigated for applicability to Vandenberg.

The Space Transportation Company (SpaceTran) proposal offers to extend capital (for a fifth Orbiter) for the right to represent (broker) commercial and foreign users of the fifth Orbiter. That Orbiter would be made available to DOD in an emergency. As we understand it, DOD use of the fifth Orbiter would be the subject of bilateral (DOD-SpaceTran) or trilateral (DOD-NASA-SpaceTran) negotiations and agreements.

Question 5: A couple of months ago, Secretary Orr was quoted in a Houston newspaper as saying he was unwilling to support a fifth orbiter either financially or politically. Could you reconcile this assertion with your statement today?

Answer: Secretary Orr's comments were taken out of context. He was commenting that, given the current back log of urgent unfunded defense requirements for which the Air Force is responsible, we could not, in good faith, support "politically or financially" any proposal for DOD funding of a fifth Orbiter. Attrition tolerance and eventual Orbiter wear out, are the source of the requirement for the fifth Orbiter. We support a fifth Orbiter funded through NASA as a necessary element of the National requirement.

Question 6: We understand that NASA and the Air Force have completed a "mixed fleet" analysis which projects the future requirements and mix of Space Shuttle and Expendable Launch Vehicles.

(a) What are the Air Force conclusions and recommendations from this activity?

Answer: The study is not yet complete. Tentative findings show the following:

- There are a number of reasons for a "mixed fleet:" Shuttle traffic supplement, avoidance of dependence on a single system, unique missions not physically and/or economically possible with the Shuttle, and transition coverage during early Shuttle operations

- Each reason has its own characteristic "mixed fleet" which is not necessarily applicable to the others

- Each characteristic "mixed fleet" must be judged on its own merits since there is no "common" mixed fleet

- The "Shuttle traffic supplement" mixed fleet stresses support of those payloads which do not have sufficient priority to command a Shuttle ride in the mid to late 1980's. These payloads are generally communications spacecraft. The mixed fleet proposals generally support retention of existing Expendable Launch Vehicles as a continuing measure until the Shuttle capability expands. The NASA retention of the Delta and Atlas Centaur is an example of this type of mixed fleet.

- The "Avoid a single launch system" mixed fleet stresses retention of a universally capable back up to the Shuttle. "Universally capable" implies that the alternate system can support the launch requirements of any Shuttle payload. No current Expendable Launch Vehicle can do this; therefore, a development program must begin to expand the capability of the Titan to improve its capability. Periodic flights of the vehicle must be scheduled to insure that the launch crew stays current. Payloads must be redesigned either to eliminate dependence upon a manned launch system or to provide an alternate unmanned launch mode. Various internal DOD proposals for Titan/Centaur fall into this category.

- The "Unique missions" mixed fleet requires the development of a unique vehicle to complement the Shuttle. Two concepts at either end of the capability spectrum are being considered: a small military-oriented vehicle designed for launch in crisis situations and a very large general use bulk carrier (a heavy lift vehicle). The former is designed to meet the unique requirements of a survivable launch vehicle/mission platform. The latter is designed to provide economical transport of large volume/high weight cargo in a non man-rated (and, therefore, less expensive) launch vehicle.

Alternatives for the Heavy Lift vehicle include uprated Titans and Shuttle Derived Launch Vehicles. Both concepts are being studied in the Advanced Military Space Flight Capability (AMSC) program.

- The "Transition Coverage" mixed fleet is intended as a risk reduction measure during the high-risk period of the operational introduction of the Shuttle. It involves retention of existing Expendable Launch Vehicles and compatible payloads during the early operational period of the Shuttle. The DOD has followed this policy in the past and is now planning to phase it out. We have three Titan back up vehicles procured. We have reached the point of diminishing returns on additional vehicles (assuming continued success with the Shuttle): additional Titans won't be available until 1987 (42 month build cycle), payloads in that period are generally Shuttle unique requiring significantly improved Titan performance or redesigned payloads to make the payload and Titan compatible, and the Shuttle has been consistently successful. Pending completion of the study the Air Force is following a course which provides for mix fleet coverage during the shuttle transition period.

Question 7: What kind of military system is the Shuttle? For instance, could it be a potential platform or control system for strategic weapons?

Answer: The Space Shuttle is three different military systems: A transport, a laboratory, and a mission platform. As a transport, it is simply a carrier of bulk cargo to a prescribed destination. In that mode, it is similar to a cargo aircraft, or for that matter, to one of the Expendable Launch Vehicles it replaced. All DOD missions involving deployable spacecraft use the Shuttle in this mode.

As a laboratory, the Shuttle becomes a flying test bed for military experiments. Except for the purpose of the experiments, this use of the Shuttle will be indistinguishable from any other scientifically oriented Shuttle launch.

As a mission platform, the Shuttle Orbiter with associated systems in the payload bay may become a military vehicle.

The Shuttle is not a potential platform or control system for strategic weapons. A strategic weapon system could not cope with the outages imposed by dependence upon the Shuttle. Any attempt to maintain continuous capability on orbit would be impossible given a four Orbiter fleet and the other demands placed on it. Further, the Space Shuttle is not a survivable system. It has numerous critical modes in its ground processing which could deny launch or continuing in orbit capability. The Orbiter in orbit is very vulnerable because of its very low maneuverability (low thrust, high weight). The Shuttle is a poor choice as a integral portion of a strategic systems platform.

Question 8: Why hasn't the Air Force picked up a larger share of the Space Shuttle procurement costs?

Answer: The Air Force "share" of the Shuttle development funding was determined by its share of the development responsibilities. Our contribution to the Shuttle program development (notably Vandenberg, the Inertial Upper Stage, the Consolidated Space Operations Center and payload transition to the shuttle) represents a financial contribution approximately equal to the Air Force use of the Shuttle System. The Air Force "share" of the operations cost is determined by a jointly negotiated pricing policy between NASA and DOD. In that policy, the DOD is credited with the manpower it must employ (with no repayment) toward the operation of the Vandenberg for all users (civil and military). In return DOD does not reimburse NASA for the NASA manpower at Kennedy and Johnson which support DOD launches. DOD does pay the same cost as any other user for the hardware used in the Shuttle launch. That cost $12.2M (in FY 75&) is the same amount as is paid by civil/foreign users through Fiscal Year 1985. In a tentatively agreed update to that pricing policy, the DOD agreed to raise their payments to $16.0M (FY 75); thereby, paying more than a civil user for the comparable hardware. NASA has raised their price to the civil and foreign users for FY 86 to FY 88 launches. A comparable increase to the DOD payment is in negotiation.

Mr. FLIPPO. Thank you very much, Mr. Secretary.

Mr. Secretary, would the Air Force be willing to fund the fifth orbiter? [Laughter.]

Mr. ALDRIDGE. I anticipated that question.

When the agreements were reached, actually in 1977, the actual formal agreement in which the Air Force would pay a reasonable share of the total Shuttle development cost, which included the procurement of Vandenberg, the development of the inertial upper stage and the transition of all the DOD payloads to the Shuttle program, we felt that that was a reasonable share to pay for at that time, and then NASA would develop and procure the orbiters and operate Kennedy.

It was agreed that the funds would be split between the NASA program and DOD. If it was in agreement at that time and the administration and the Congress, which I understand supported that particular agreement at that point, had put the money in the DOD budget for buying orbiters, we would have been buying orbiters today.

Our problem is, at this late date, to transition out of that plan. We have not planned that in our program, and if we are now forced to go and procure an orbiter for which we have not programed, it would be done at the expense of other DOD programs which we have planned.

We support NASA's continuing to procure the fifth orbiter for a multiplicity of users, but if we found any reason why there is a dedicated need and a unique need for DOD to pay for one of the orbiters, we would certainly fund it. The same thing is true for any other unique requirements.

But right now, sir, we believe that NASA ought to fund it as part of the original agreement, and we would continue to do our part of the total procurement of the Shuttle program.

Mr. FLIPPO. Mr. Secretary, in fact there have been many different agreements and understandings between NASA and the Air Force. Is that correct?

Mr. ALDRIDGE. No, sir. I am only aware of one agreement, 1977, reaffirmed in 1980. Back at the time you mentioned, in 1972, there were discussions going on about who was going to pay, and I remember some of those discussions that were occurring between the administration. At that time the Air Force was thinking about buying two of the orbiters, but at that time it was thought of as those orbiters being dedicated to Air Force use, painted Air Force blue, not the concept by which we operate now and the concept by which we operated starting in 1977, where all orbiters would be shared.

Mr. FLIPPO. But there was an understanding previous to the 1977 agreement that the Air Force might perhaps, in accordance with Secretary Seamans' testimony before the Congress, finance their own vehicles at such time as the Shuttle has been demonstrated.

Mr. ALDRIDGE. Sir, I think that was under the understanding that those Shuttles would be dedicated to the Air Force for that purpose.

Mr. FLIPPO. Well, I think NASA, Mr. Secretary, would be agreeable to painting them Air Force blue. [Laughter.]

What we are really talking about is funding. But I think the point is that there have been several different understandings, and I suppose I won't haggle over what is an understanding, what is an agreement, and that sort of thing, but I think that this clearly shows that there were understandings under which the Air Force would acquire certain orbiters and build certain facilities for Air Force use.

At any rate, as to NASA's funding, I think it is clear that there has been some discussion at some time or another for the Air Force to acquire orbiters. If that is not the current situation today, then the agreement or the understanding has changed.

I just wonder if you wouldn't be willing to acquire the fifth orbiter. Would you be perhaps willing to support a more equitable arrangement with regard to the operational costs, perhaps as has been proposed by Senator Schmitt?

Mr. ALDRIDGE. No, sir. That is not an equitable sharing of the costs. We are in negotiation with NASA right now about what is a fair launch service that is more along the lines of comparable sharing between commercial and DOD launches. Dr. Cook is involved in that negotiation, and we are in fact looking at changing the fees that have been shared so that we do pay a more equitable share of the cost of launches.

Mr. FLIPPO. When do you anticipate the completion of that?

Mr. ALDRIDGE. Sir, we are waiting for NASA to come forth with a proposal for what the price charges ought to look like in certain points in time. Of course, we are talking about 1985, quite a few launches in the operational mode before it makes any difference.

Mr. FLIPPO. I understand, Mr. Secretary, that NASA has made such a proposal. Do I now understand that they have not?

Mr. ALDRIDGE. No, sir, they have not, not an official proposal to us.

Mr. FLIPPO. I appreciate the Secretary's testimony.

Mr. Hollenbeck.

Mr. HOLLENBECK. Thank you, Mr. Chairman.

A couple of months ago, Secretary Orr was quoted in a Houston newspaper as saying that he was unwilling to support a fifth orbiter, either financially or politically.

Mr. ALDRIDGE. We clarified that, meaning in the Air Force budget. He supported the fifth orbiter to be funded under the NASA budget but not in the Air Force budget.

Mr. HOLLENBECK. Now, we are going, as I mentioned before, to be hearing today from a private group interested in purchasing a fifth orbiter. Would DOD be willing to purchase launch services from a private operator?

Mr. ALDRIDGE. Sir, there are so many questions yet to be resolved. I don't know how to answer that.

Mr. HOLLENBECK. Well, maybe, then, you can raise those questions from a DOD perspective, because I think that is as important as having the answer.

Mr. ALDRIDGE. Yes, sir. Yes, we are undertaking that at this point.

Mr. HOLLENBECK. Can you raise some questions today for the record?

Mr. ALDRIDGE. Well, I have problems with the question of security, the question of will DOD continue to have the priority given that they have sold a particular orbiter flight to a commercial firm who needs, say, a satellite in orbit to meet its responsibilities. Can we get on board that, or is that fifth orbiter really available to us to meet our mission model? Those are questions that I do not yet have answers to.

I guess there are some legal problems in the sense of our actually developing this particular vehicle and having, then, a commercial firm come in and pay just the procurement costs of it. How about the issues of other companies that may want to have launch services of some sort? Is it unfair competition issues that get raised in this particular agreement?

Last, I think the question is of what benefit is it to the Department of Defense? We can meet our mission requirements with the four orbiters so long as we get the turnaround time, and we can continue to have our priorities, and it may be necessary for the fifth orbiter for commercial users, but I am not sure what benefit it really has to the Department of Defense.

Mr. HOLLENBECK. Thank you.

Mr. FLIPPO. Mr. Winn.

Mr. WINN. Thank you, Mr. Chairman.

Mr. Secretary, isn't it really the game plan to continue as you have been working together as a team with NASA?

Mr. ALDRIDGE. Absolutely.

Mr. WINN. I understand the concern of members of the subcommittee, because we have had many discussions about it in the committee and in the full committee, about trying to get the Air Force to pay maybe more than it is paying at the present time, but all of these figures and projections are worked out between the two agencies; are they not?

Mr. ALDRIDGE. Yes, sir. Again, it is part of the agreement that we had in 1977, which we have carried forth, and both agencies are

satisfying their commitment to that agreement in spite of changes in costs, in spite of changes in schedule, in spite of changes in the mission model; we are still following through with those basic principles of that agreement.

Mr. WINN. Well, as you said, it is what you feel and what you recommend to Congress for funding and what you recommend to OMB for funding; it is what is best for the American people.

Mr. ALDRIDGE. Yes, sir.

Mr. WINN. And you work in consultation, continuous consultation with NASA. And there are changes that will be made constantly, and more in the future.

Mr. ALDRIDGE. Yes, sir. You are right.

Mr. WINN. And the situation may change, where we may need more military experiments aboard, or less, depending on the situation as time progresses.

If you experience any problems as far as the line of questioning is concerned, your main problem is to sell OMB, isn't it?

Mr. ALDRIDGE. Sir, I really don't have a problem with OMB. If we can make our case and have a strong rationale for our program, I don't have any difficulty selling OMB. I find sometimes they are very useful because they ask questions which allow our case to become stronger. I don't have any basic quarrel with them. If we cannot make our case to OMB, we sure are not going to make it up here because there——

Mr. WINN. Wait a minute. I don't know what you said there. [Laughter.]

You may want to rephrase that.

Mr. ALDRIDGE. If our case is so weak that we cannot get through OMB, then certainly the weakness is going to show before the congressional committees which review our budgets.

Mr. WINN. Well said. [Laughter.]

OMB has been pretty supportive of the Space Shuttle program, no matter whether it is involved on the military side or the NASA agency.

Mr. ALDRIDGE. Yes, sir, I think that is correct.

Mr. WINN. I don't believe I have any more questions, Mr. Chairman. Thank you.

Mr. FLIPPO. Mr. Lowery.

Mr. LOWERY. Thank you, Mr. Chairman.

Did you say that OMB is on your case worse than we are? [Laughter.]

Is that the proper interpretation of your remark?

Mr. ALDRIDGE. There are those occasions; yes.

Mr. LOWERY. How much of the Air Force budget is dedicated to NASA—maybe I should say that more broadly—to space?

Mr. ALDRIDGE. Our total, we have about $8.5 billion in our program, fiscal years 1983 through 1987, to support the Shuttle program, and that supports about 25 flights during that period for DOD.

Mr. LOWERY. Is that your total for space? You mentioned Shuttle specifically. Are you not at all involved in other areas, or is that information classified?

Mr. ALDRIDGE. Yes, sir. Let me make sure what is all included. General Randolph can probably give you a specific answer on that.

Mr. LOWERY. And if you have that as a percentage of the total Air Force budget.

Mr. ALDRIDGE. Well, the total Air Force budget, of course, beyond 1983 is a little bit uncertain at this point; in fact 1983 is a little bit uncertain. But we are asking for about $75 billion in fiscal year 1983 for the Air Force, and I believe our total space budget is approximately 6 or 8——

General RANDOLPH. It is 8 percent.

Mr. ALDRIDGE. It is 8 percent of the total Air Force budget that is dedicated to space systems.

Mr. LOWERY. You say $8.5 billion of $75 billion?

Mr. ALDRIDGE. $8.5 billion is the total estimated investment for Shuttle-related activities for the 25 shuttle flights.

Mr. LOWERY. Over several years?

Mr. ALDRIDGE. Over the next 5 years.

Mr. LOWERY. OK, but each year you spend roughly 8 percent of the total Air Force budget on space-related activities.

Mr. ALDRIDGE. Yes, sir.

Mr. LOWERY. We talked about a fifth orbiter. I am not sure I quite understood your response. Would the Air Force prefer to have its own dedicated, Air Force shuttles?

Mr. ALDRIDGE. No, sir. What we need is the availability of a shuttle flight when we need it. It is better to draw from an inventory of five orbiters than it would be to draw from an inventory of one which belonged to us. I believe it would be better for the country to have a total inventory that we could move around and have available at any time, given that that orbiter could be down for maintenance or overhaul or whatever.

Mr. LOWERY. I understand it is an accounting measure in terms of whose budget that comes out of. It is all the same taxpayers' pocket.

Mr. ALDRIDGE. Let me just make a point.

Mr. LOWERY. But it seems to be a little easier to get that money into the Air Force's pocket than NASA's pocket.

Mr. ALDRIDGE. I don't concur in that, necessarily. I think it is a national program that should be funded by the American taxpayer, and the orbiter is a multiple——

Mr. LOWERY. And is, regardless of where we spend it.

Mr. ALDRIDGE. And it is, regardless of where the money comes from.

The point I guess I am objecting to is there is an implication that if the Air Force funds the fifth orbiter, the funds will come from the total DOD budget. We would have to decrease other programs to pay for the fifth orbiter. That is the basic contention, that we don't believe we ought to be trading off an orbiter for other critical national DOD programs. I mean, no evaluation has been made of the relative priority that has been given to that action. We had not planned for that, and a tradeoff analysis would have to be done if we were to procure the fifth orbiter.

Mr. LOWERY. If the Air Force ran their own fleet of orbiters for their own purposes, how many would you need?

Mr. ALDRIDGE. We can get by with four orbiters.

Mr. LOWERY. Is there anything on the drawing board for a military version, if you will, of an orbiter, I think possibly in the out years, not near term?

Mr. ALDRIDGE. Not to my knowledge, sir. We have discussed the possibility of a block II orbiter with maybe some improved capabilities, but those are just in discussions between ourselves and NASA.

Mr. LOWERY. Is that like a B–1 orbiter? [Laughter.]

I don't mean to be facetious. The Soviet Union has said a great deal about the Shuttle. They seem to be very concerned. Could you elaborate on why? I mean, do they see it as a potential platform or a control system for strategic weapons?

Mr. ALDRIDGE. It is hard for me to speak from the standpoint of the Soviet Union.

Mr. LOWERY. Have you had any communication, direct or indirect, with the Soviets?

Mr. ALDRIDGE. Have I? No, sir.

Mr. LOWERY. Or the Department of Defense?

Mr. ALDRIDGE. Well, there were some negotiations for an antisatellite treaty during the last administration. During those talks, the Soviets viewed the Shuttle as a potential antisatellite system. I think the Soviets are viewing it from their own point of view. If they could get the United States off the Shuttle program and get it canceled, I think they would feel that was a great boon to them, for obvious reasons: The Shuttle gives us great national prestige; it is quite obvious example to the world of our technology; it clearly shows that we are far ahead of them in our technology with regard to space operations; and I think it is detrimental to their cause, and they would like for us very much not to have the Shuttle program.

Now, it always has been, from the very beginning of the Shuttle, that this was a program that supported both military and civil needs. Otherwise, we could not have made the case for the orbiter and the orbiter program. We are very much committed to the orbiter at this point in time. It is essential that we make it work and we get the facilities and the spare parts to get it turned around quickly so we can continue to meet our mission model requirements.

We think all of those reasons support both making it a viable program and the fifth orbiter as an essential part of it.

Mr. LOWERY. Aren't the Soviets concerned a bit more specifically than merely the prestige and advantage that we gain?

Mr. ALDRIGE. I don't think so. I think they clearly know what we are going to use the Shuttle for. I think it is a scare tactic, perhaps. They attend all these hearings. They know exactly what we are trying to do. I think it is just a——

Mr. LOWERY. You haven't sent any observers to their meetings in the Kremlin, their space subcommittee?

Mr. ALDRIDGE. No comment. [Laughter.]

Mr. LOWERY. Thank you, Mr. Chairman. Thank you, Pete.

Mr. FLIPPO. Mr. Secretary, I just think this committee would like to encourage you. Have you communicated your support for the fifth orbiter to OMB and the administration?

Mr. ALDRIDGE. Yes, sir.

Mr. FLIPPO. Have you told them this is the official Air Force position?

Mr. ALDRIDGE. Yes, sir, well, let me say that it is not only just the Air Force position; my understanding is it is the Department of Defense position as well. My testimony was cleared by the Office of the Secretary of Defense, so we are supporting it.

Mr. FLIPPO. I think the committee would just like to encourage your continued support and continued communication with OMB and the administration regarding the cost problems that we are being faced with and the reasons for your support.

Mr. ALDRIDGE. Yes, sir.

Mr. FLIPPO. Thank you very much for your testimony. We appreciate it.

Mr. ALDRIDGE. Thank you, sir.

Mr. FLIPPO. Our next witness is Dr. Jerry Grey, administrator for public policy of the American Institute of Aeronautics & Astronautics.

Dr. Grey, it is a pleasure to have you with us. We realize the hour is late. Please feel free to summarize. We will, of course, accept the entire statement for the record, and please feel free to summarize as you deem appropriate.

STATEMENT OF DR. JERRY GREY, ADMINISTRATOR FOR PUBLIC POLICY, AMERICAN INSTITUTE OF AERONAUTICS & ASTRONAUTICS

Dr. GREY. Thank you, Mr. Chairman. I will do that.

I would like to touch on just a few of the points we have made, though. In the light of some of the previous testimony, they might have some bearing on the discussion.

We have concentrated principally on the non-Federal requirements for the Space Shuttle. You have heard now from NASA and from the Department of Defense regarding basically the Government's requirements. We have heard only a little about some of the commercial projections, I think the final witness today will be very interested in those, and some of the work that we have done might be pertinent to that.

We did a study about 1½ years ago. That study, we believe, is still pertinent; in fact, it is even more pertinent now than it was at that time. I would like to state just one quote from it: "The administration's proposal to reduce funding for the fifth shuttle orbiter and to limit the procurement of expendable launchers would result in a direct and substantial economic loss to the United States." We think that statement is even stronger today in view of Ariane's initial activities and future projections.

Let me summarize a few of the main conclusions that we came to which are pertinent. First, we concluded that the projected space transportation system capacity, by itself, will be unable to meet projected user demand through at least the latter portion of the 1980's, and that is even if none of the highly advanced technology missions that we had projected might occur; that is, space processing, some of the large-structure requirements, and so on. It was our judgment, however, that some of that demand will develop and therefore exacerbate the situation even further.

The second point we made was that operational problems are certain to be encountered. We have heard much discussion today about them. It would be nice if we were able to meet our turnaround specifications, and it would be nice if we didn't have any severe anomalies that might delay orbiters or lose an orbiter, but we know, based upon our past experience, that it is likely that such anomalies will happen.

We evaluated in some detail the X-15 program, which is very different from the Shuttle but nevertheless involved a comparable advancement in capability over previous vehicles. We found that there were a number of serious anomalies which delayed flights on that program over the period of time during which it flew. It was a very successful program, but there were delays. Shuttle turnaround delays will affect launch rate assurance, and therefore would also affect many of the activities that are required for commercial as well as military priority operations.

We also found that not only would the fifth orbiter be a requirement, and possibly a sixth beyond that, but there are other concerns besides the orbiter. Mobile launch platform capability is limited, and certainly the facilities at the Kennedy Space Center are limited. We are not sure yet what the facilities at Vandenberg will look like, but it is probable that they will face some of the same problems.

We also decided it was necessary to have an adequate supply of expendable launch vehicles to back up the schedule, as was mentioned by NASA witnesses earlier today. Whether or not that backup capability provided is important, and we ought to know that it is available.

We summarized these points and, in fact, our computer study in an article which appeared 1 year ago. I would like to have that entered in the record if possible. This article elaborates on the conclusions that I have just stated.

Mr. FLIPPO. Without objection, it is so ordered.

[Material to be provided follows:]

Case for a Fifth Shuttle *and* More Expendable Launch Vehicles

BY JERRY GREY
AIAA Administrator, Public Policy

To establish the proper production level for Space Transportation System (STS) elements, particularly Orbiters and orbital-transfer vehicles, the national planner needs to know total demand over the period in question. Commercial traffic especially affects a projection, because it necessarily includes many activities not yet firmly scheduled on NASA's Space Shuttle manifest. Wishing to clarify the demand outlook, the President's Office of Science and Technology Policy (OSTP) asked AIAA to define space transportation demand for this non-federal, commercial sector through the year 2000.

The Institute received the request on October 23, 1980, and on October 28, by a cautious 10-to-8 vote (with three abstentions), the AIAA Board of Directors approved the undertaking. One of the Board's concerns was the extremely tight deadline. To be useful in FY82 budget deliberations, a preliminary draft of the report had to be in OSTP's offices November 26—just one month from the "go" date. Linked to this "short fuse" was the Board's concern that the Institute not prejudice its technical and professional credibility (the basis, according to OSTP, of its request to the Institute to perform the study) by biting off more than it could chew under such a tight time constraint.

An ad hoc task group (see box) was assembled and, with only a single meeting, was able to gather, distill, interpret, and assess the necessary data. The preliminary draft was delivered on time, and served as a key background document for FY82 budget decisions on maintaining the option for a fifth Shuttle Orbiter. The AIAA Board of Directors approved release of the final revised version of the study at its January 14 meeting in St. Louis. What follows represents some highlights of the report officially released January 19.

The AIAA ad hoc task group identified in the box estimated non-federal demand for space transportation services from 1980 to the year 2000 from a variety of sources, governmental and private, with non-NASA information constituting the principal basis for quantitative projections.

Requirements for launch services are reasonably well defined for the early 1980s, particularly in the communications sector, which will likely constitute well over 75% of the total nonfederal demand for the foreseeable future. The 1990s will see increasing non-federal demand, both in communications and in new space activities, but the detailed composition of that demand is not at all clear.

The time constraints of this study necessitated some simplifying assumptions. The two most sensitive involve translation of the relatively firm demand for transponders in geostationary orbit into equivalent Space Shuttle payloads and the fraction of non-government foreign launches that will be flown on U.S. space launchers. For the purposes of this study, the task group assumed that 60 "reference" transponders (30 MHz bandwidth) correspond to one full Shuttle Orbiter payload and that a third of non-government foreign payloads will be captured by U.S. launch systems. The full report explains in detail the rationale for making these assumptions.

According to the task group's estimates, the projected STS capacity will not meet projected demand even in the latter part of the 1980s. It will not do so even if *none* of the anticipated non-federal demand materializes in the advanced-technology sectors dis-

THE TASK GROUP

The following AIAA members formed the ad hoc task group: Leonard David of George Washington Univ., Burton I. Edelson of Comsat General, Robert R. Gilruth, Consultant, Gilbert Keyes of Boeing Aerospace, John Logsdon of George Washington Univ., Ashok K. Sinha of Comsat General, and Adelbert O. Tischler, Consultant.

Aerospace companies, NASA, and the ad hoc task group all supplied data. Thomas Brownell of Boeing Aerospace, Charles Gould of Rockwell International, Jesco von Puttkamer of NASA, James Rose of McDonnell Douglas, Donald Turner of NASA, Donald Waltz of TRW, and Stanley Weiss of NASA made notable inputs. The report was assembled and edited by Jerry Grey, AIAA Administrator of Public Policy.

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Everything points to more roll-outs like this needed to meet demand.

Commercial demand for space launches through the year 2000 justify at least maintaining the option for a fifth Shuttle Orbiter, greatly increasing the supply of expendable launch vehicles, and paying close attention to operational problems that would alter launch rates

cussed in the full report. Any of that advanced-technology non-federal demand that does materialize—and it surely will—will widen the discrepancy between demand and available launch services.

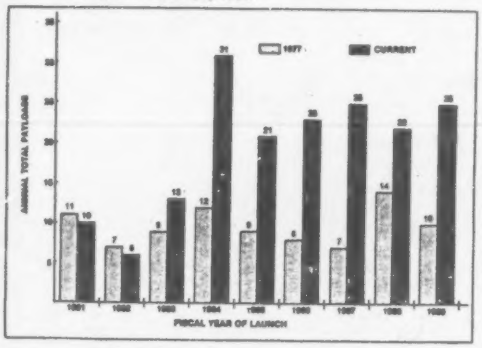
Initial Space Shuttle operational problems will almost certainly spread this gap. Principal areas of concern include launch-rate assurance (adversely affected, for instance, by delays in Orbiter turnaround and saturation of launch facilities), orbital-transfer limitations due to the need for a suitable high-performance upper stage, and the economic necessity of maintaining launch schedules for commercial customers. Deletion or delay of NASA advanced technology development flights to meet firm launch obligations, preemption of launch vehicles for military emergencies, and diversion of capital investment by industry to non-space endeavors (due to uncertainties in launch availability) could also significantly affect demand for launch services.

Additional STS capability, the AIAA task group concludes, will be needed to relieve schedule and capacity constraints that appear to be imposed by the now limited numbers of Space Shuttle Orbiters and mobile launch platforms and by the capacity of certain facilities at the NASA Kennedy Space Center (KSC). Moreover, steps should be taken immediately to insure an adequate supply of expendable launch vehicles to meet the stringent schedules of commercial customers until the Shuttle has fully demonstrated the needed operational capacity and reliability.

The *firm* commercial payload requests appearing on NASA's Space Shuttle manifest are essentially all communications payloads. The growth rate of commercial demand (again, essentially all communications) can clearly be seen by comparing the projections in a 1977 joint DOD/NASA study requested by the Office of Management and Budget (OMB) with the current NASA projection of both foreign and U.S. commercial payloads (see chart on page 24). Projected communications traffic has increased by at least 35% since 1977, and new long-range predictions place the compound annual growth rate at 24%. The new projection foresees more than double the number of foreign and commercial payloads previously expected between 1981 and 1990.

The STS will not capture all this satellite traffic, because other countries will be offering launch systems at competitive prices and schedules. The European Space Agency's Ariane space launch vehicle offers about the same service as Atlas/Centaur, and Ariane II and III will offer more. Because of development delays in the Shuttle program and NASA's reluctance to order Atlas/Centaur vehicles beyond what had been ordered for pre-Shuttle use, Intelsat

RISING ESTIMATES OF GEO PAYLOAD REQUIREMENTS
Compares 1977 and July 1980 NASA estimates for foreign and domestic commercial payloads.



has now assigned launch responsibility for three Intelsat V satellite systems to Ariane. China and Japan, moreover, are both developing vehicles capable of launching communications satellites, as described further in the full report.

These competing vehicles complicate projections of future payload assignments to our STS. NASA's projections of Shuttle flight requirements, for example, are based on capture of a third of the expected foreign communications-satellite traffic. Other projections suggest the capture of two-thirds. But the Shutttle, when equipped with upper stages, should be able to offer transportation at costs significantly less than those for totally expendable launch systems, despite the benefit offered by near-the-equator launch sites such as Ariane's.

Hence our STS should have distinct competitive advantages whenever national prestige does not command the decision.

In this outlook, the task group emphasizes, much depends on the mission successes demonstrated by the various launch vehicles, including the Shuttle, during their demonstration flights.

The task group expects demand for telecommunications services to increase dramatically by the year 2000 owing to many factors, such as the following—

—An expanding and modernizing world population.

—Ever-growing desire by government and commercial sectors for modern public service, business, and entertainment telecommunications.

—Technological advances that enable computers to be "tied together" worldwide for the transmission of data at high rates.

—Rising travel costs boosting the use of TV communications.

—Decreasing per-channel costs of satellite communications compared to terrestrial alternatives.

By 2000 the overall world demand for telecommunications services may grow by about a factor of five. *The growth in traffic handled by communication satellites will be even greater, perhaps by a factor of ten to thirty.*

Moreover, pressing upon existing C- and Ku-band technology are the political facts of life, such as the refusal of developing countries to relinquish orbital slots even though they will not be in a position to use them in the period under consideration.

The task group therefore concludes that the present operational frequency spectrum—even the extended frequency bands allocated by the 1979 World Administrative Radio Conference—will not be able to handle year 2000 communications and remote-sensing demands (treated in the full report). In particular, the uplink of 6 GHz and downlink of 4 GHz (C band) should be nearly saturated by the late 1980s. The 14-GHz uplink and 11-GHz downlink (Ku band) will likely be saturated by the late 1990s. Even with the expected new technologies (frequency reuse, TDMA, etc.) these lower-frequency bands will probably not be able to carry the demand.

One obvious approach to alleviate the inevitable telecommunications logjam—higher frequency bands such as 30/20 GHz to carry the increased demand—has been pursued actively by NASA. The agency has plans to fly a 30/20-GHz experiment on

PROJECTIONS FOR NON-FEDERAL SPACE PROCESSING AND MANUFACTURING PAYLOAD TRAFFIC USING U.S. LAUNCHERS
Table summarizes several projections discussed at length in AIAA's full report and represented by a band on the graph on the opposite page.

	Equivalent full-Orbiter payloads					
Estimator	1985	1990	1995	2000	Total	Annual average
Battelle[a]						
High	1	½	0	—	1½	0.1
Low	½	½	0	—	1	0.07
Rockwell[b]						
High	1	6	13½	21	41½	2.1
Low	1	1	4	5	11	0.55
NASA[c]	1	22	25	28	76	3.8
AIAA Task Group	1	5	9	18	33	1.65

[a] "Outside Users Payload Model," Battelle Columbus Laboratories, Report No. BMI-NLVP-IM-80-4 to NASA (Contract No. NASw-2018), Apr 1980.
[b] "STS Mission Model Projection (1980-2000)," Rockwell International, informal communication, Nov 1980. Commercial demand arbitrarily assumed to be half of total demand for space processing and manufacturing projection.
[c] Von Puttkamer, Jesco, "Unofficial Assessment of Shuttle Flight Opportunities for New Initiatives," Nov 19, 1980 (NASA). Commercial demand arbitrarily assumed to be one-fifth total new-initiative demand.

the Shuttle in 1985. Such extra-high-frequency bands could enter the commercial scene by 1990.

The prospect for multipurpose geosynchronous platforms, or "antenna farms," looks quite good. However, the task force does not consider the effect of this development on total payload significant. If one-third of all communications traffic could be handled by 1000-transponder platforms, the net effect on the projections would be a decrease in 1995-2000 launch demand of about 8%—a maximum reduction of 5% in cumulative Shuttle launches through the year 2000. Hence this factor was not explicitly considered in the AIAA projection.

The recent surge in communications-satellite planning brings with it a surge in demand for expendable launch vehicles, aside from the Shuttle capacity. In September 1979 no expendable launch vehicle (Delta) flights were projected for either FY84 or FY85. By September 1980, only one year later, ten were projected for FY84 and six for FY85. *The 1983-86 requirement jumped to about 71 expendable launch vehicles to carry payloads outside the Shuttle-budgeted traffic.* That averages about 12 Delta flights and 4-6 Atlas/Centaur flights per year.

The need for expendables, moreover, may continue to grow in the face of Shuttle *success*. The dominant communications-satellite business cannot afford delays in launch schedules. Delays spell big lost revenues. Commercial satellites *must* be launched on rigorous schedules. Yet meeting the stringent schedule demands of commercial customers may interfere with NASA's using the Shuttle to develop new applications of space that would increase demand for space transportation. If launch services become saturated or too uncertain, companies interested in investing in space may direct their capital elsewhere. Moreover, military needs could preempt flights scheduled for commercial payloads.

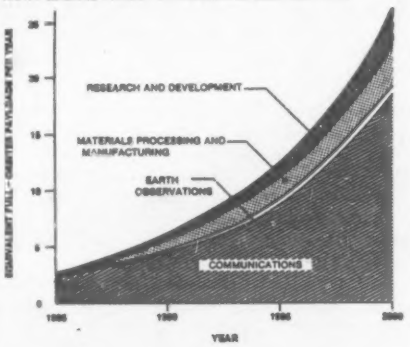
To this picture may be added unanticipated delays in Shuttle scheduling due to operational problems or failures and overoptimistic turnaround projections. They would erode future Shuttle demand and up the demand for expendables, particularly from foreign suppliers—an adverse economic turn for the U.S.

The Orbiter, the vehicle assembly building, and the mobile launch platform (MLP) set limitations on Shuttle launch rate from KSC. Refurbishment and reloading of solid-propellant booster rockets (SRBs) represent another limit, perhaps more malleable.

It is impossible to project exactly the annual number of Shuttle flights per Orbiter. Such projection of future operations can only be made on the basis of average time allowances for the several parameters that affect flight-time spacing. Turnaround time (for typical maintenance and servicing of the many vehicle components) affects projections most. Other prominent factors include mean mission duration, contingency and anomaly time (allowances for uncontrollable factors such as weather, minor repairs, and equipment replacement), and the number of KSC work days per week and shifts needed to meet tight flight schedules.

NASA initially projected a turnaround time of 160 hr. Recent simulations of operations show turnaround time will depend on the payload and whether the Orbiter can be loaded horizontally or vertically. These simulations indicate an average turnaround time of about 280 hr. This figure, plus an average contingency time of five days, and a mean mission duration of 1.6 days yield about 10 flights per year per Orbiter. A 7-day work week at KSC might increase this to 14 flights per year per Orbiter. Reduction of turnaround time to the originally estimated 160 hr while maintaining other factors constant and a 5-day work week yields 17 flights per year per Orbiter.

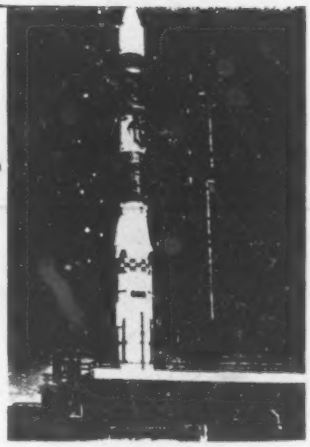
AIAA PROJECTION OF LAUNCH DEMAND FOR ALL NON-FEDERAL PAYLOADS TO FLY ON U.S. VEHICLES



A four-Orbiter fleet would therefore be limited to about 40 flights per year. That many flights per year would not be possible with facilities now under construction.

KSC has only two MLPs. With a two-shift, five-day week the two MLPs would limit flights to about 25 per year. A seven-day week would raise this to about 34 flights per year.

Moreover, the planned SRB-refurbishment facilities limit flight rate to a maximum of 19 per year.



Without U.S. expendables foreign launch vehicles like this Ariane will reap a big market.

(SRB refurbishment, it should be noted, represents an operationally untried and sensitive technology. Should refurbishment prove impractical, the existing production capacity for SRBs would limit Shuttle flights to no more than 3 per year.)

NASA projections of STS vehicle requirements to meet the anticipated traffic assume *no* attrition of the vehicles themselves. In view of the developmental nature of the Shuttle system, the task group considers this assumption questionable.

NASA's turnaround planning does assume anomalies in avionics, thermal protection, propulsion, etc., and even in the payloads, but no one can predict how debilitating such anomalies may prove. The most similar prior vehicle—although a far cry from the Shuttle—the rocket-propelled X-15 research aircraft, as a three-vehicle fleet flew a total of 199 flights. Minor anomalies occurred every 3.7 flights, causing downtimes ranging from 2 to 5 weeks. Major anomalies occurred every 12.5 flights, causing an average downtime of 11 weeks. The greatest number of missions flew 7 to 14 days apart, whereas in principle, the X-15 could have flown once a day.

In view of the investments in payloads and the extreme dependence of commercial operations on maintaining schedules, NASA needs to maintain sufficient vehicle reserve to cover downtime contingencies arising from routine operations, the task group concludes. *Moreover, projected Shuttle capacity, even without contingencies, will not meet projected flight requirements. Expendable launch vehicles must continue to shoulder a significant portion of the U.S. launch burden into the indefinite future.*

The STS with the present Shuttle basically serves low Earth orbit. Yet some 45% of the payloads scheduled from 1980-86 must go to geosynchronous orbit (GEO). To deliver them, the country will have three upper stages using solid-propellant rocket motors: the Payload Assist Modules (PAM), available in both Delta (PAM-D) and Atlas/Centaur (PAM-A) configurations (also designated Spinning Solid Upper Stages—SSUS-D and SSUS-A), and the Inertial Upper Stage. The relatively low performance solid-propellant rocket motors exact a severe penalty in payload deliverable to GEO.

An improved-performance stage using hydrogen-oxygen propellants, the task group notes, could increase GEO payload at least 20%. This large margin could increase satellite services or reduce the number of Shuttle flights needed. Studies and technology developments aimed at equipping the existing Shuttle system with high-performance upper stages are clearly desirable. This point was recognized back in 1971.

Other Limitations on Shuttle Operations: Shuttle Orbiters are not completely interchangeable between KSC and Vandenburg Air Force Base (VAFB). In addition, DOD payloads demand the greater capability of Orbiter No. 103 or 104. Furthermore, processing at VAFB will take longer than at KSC because of facility limitations. Since military demand will carry high priority, it may at times supersede other payload schedules. This augments the argument for additional Shuttle Orbiters to prevent interruptions of commercial traffic.

In this respect, the task group notes that Orbiter 102 (Columbia) will very likely be reserved for developmental flights. It may not have the payload capacity for many manifested flights, including Galileo, several DOD payloads (especially when launched from VAFB), and very probably the Tracking and Data Relay Satellite.

Even in the short period during which this report was being prepared and reviewed, both non-federal market projections and U.S. launch capability continued to change. Recent events may significantly alter the picture drawn by the task group. Two illustrations: Recent approval by the Federal Communications Commission of an additional 20 domestic communications satellites (and five more likely to be approved in the near future) and the decision by NASA to adapt the Centaur stage as an orbital-transfer vehicle to operate in conjunction with the Shuttle Orbiter for the Galileo mission.

These moves underscore the main conclusions reached by the task group. Commercial traffic alone justifies at least one more Shuttle Orbiter within this decade and necessitates reestablishing a strong stable of expendable launch vehicles as soon as possible. Without these moves the U.S. will suffer in international space business competition. ■

Dr. GREY. In the past 1½ years the situation has changed to increase, rather than decrease, our projected commercial demand forecasts. We have seen some 20 more communications satellites authorized by the FCC; we have seen a major European program, the L-Sat project, with its 30/20 gigahertz capability, which could lead to a whole new generation of larger and more powerful communications satellites; we see much more activity in the space processing field than we thought would occur 1½ years ago; not only is the first space processing flight occurring, but there is a great deal of interest in it beyond just the series of flights that have already been manifested.

We have seen, in fact, three commercial enterprises move seriously into the space transportation field: Arianespace, Space Transportation Co., and Space Services, Inc.

What we really believe is necessary at this point is not only action toward procurement of a fifth orbiter—the proposal, incidentally, by the Space Transportation Co. in exchange for commercial and foreign marketing rights is interesting—but the AIAA strongly encourages any move toward a new and more realistic pricing structure for the Shuttle and the maximum involvement of the private sector, commensurate, of course, with national security and Federal R. & D. requirements. We do have to be careful about the term "commercialization," however. It means different things when you apply it to existing standard launch vehicles, new launch vehicles, or to the Shuttle.

With regard to competition, there is no doubt that Ariane's more favorable terms and guaranteed launch schedule are draining away customers from the United States. In effect, Arianespace makes an offer that they can't refuse. As long as Shuttle space availability is constrained, as it will be for the next 4 or 5 years, Arianespace will get a good deal of that new launch business. Unless we take steps today to increase Shuttle availability beyond the 1985-86 time period, that loss of business to both Ariane and the increasing Japanese capability could cripple marketability of the Shuttle well into the future. When I say "marketability," I mean commercial and foreign marketability. This subject has been summarized in an article in Astronautics and Aeronautics, which I have submitted with our formal statement.

In summary, the major steps we recommend are the following: We think the construction of a fifth orbiter ought to be initiated, not only because of its capacity requirement but also to keep the production line open. We feel it will become necessary to have subsequent sixth, seventh, eighth, and ninth orbiters in the future. We need that production line.

It is also possible that orbiter support facilities, as I said, could turn out to be the bottleneck, and therefore continued attention to those is necessary.

We feel it is necessary to produce expendable launchers until the shuttle system has proved its ability, and also to upgrade and maintain their launch facilities.

Finally, we feel it is critical—this has not been mentioned much today—that the development of a high-performance and cost-effective upper stage, to take full advantage of the Shuttle, be initiated immediately. The Shuttle can be truly competitive only when it is

equipped with a competitive upper stage. We pointed that out, 11 years ago in an AIAA assessment of the space transportation system. It is still true today. The degree to which the lack of a suitable upper stage having high performance and low cost has prejudiced commercial activity on the Shuttle is documented in the Astronautics and Aeronautics article we have submitted with our formal statement. We do not necessarily endorse or support the specific numbers in that article—it was written by an outside reporter—but the general concept is certainly proper.

Another action that needs to be taken is to initiate an innovative pricing and sales policy which might be implemented either by a commercial activity such as STC, or by NASA itself—something that might meet the "fly now, pay later" plan that Ariane offers to its customers. We suggested at one point a royalty-type reimbursement. There are other possible innovative policies that might be instituted.

Thank you, Mr. Chairman. We would like to call to your attention our new space policy which was issued a couple of weeks ago, and I have offered a copy for the record. Some of it does pertain to the subject under consideration.

[The prepared statement, plus answers to questions asked of Dr. Grey, follow:]

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STATEMENT TO

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

ON

THE NEED FOR ADDITIONAL SPACE SHUTTLE ORBITERS

BY

DR. JERRY GREY
ADMINISTRATOR, PUBLIC POLICY

June 15, 1982

American Institute of Aeronautics and Astronautics
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The AIAA is the professional Society whose membership of over 32,000 individual engineers, managers, scientists, and students encompasses all the disciplines associated with space transportation systems. We appreciate this opportunity to appear before this Subcommittee to discuss the need for additional space shuttle orbiters.

Our basic view on this subject was expressed in testimony before this committee over a year ago, on March 19, 1981: "The Administration's proposal to reduce funding for the fifth shuttle orbiter...and to limit the procurement of expendable launchers would result in a direct and substantial economic loss to the U.S." That viewpoint, which was documented in considerable detail by the Institute,* has now been reinforced through the subsequent attainment of operational status by a competitive foreign launch-vehicle operator, Arianespace.

Although over a year old, the AIAA demand assessment is perhaps even more pertinent now than at the time it was published. Its major points address most of the issues that are of concern to this Subcommittee and to the nation today. We concluded, for example, that:

- "Based upon the firm launch commitments already made and on what past experience indicates are realistic estimates of future communications traffic, the projected space transportation system capacity will by itself be unable to meet projected user demand through at least the latter portion of the 1980's, even if none of the (projected) non-federal demand materializes in the advanced-technology sectors" (e.g., materials processing, large-structure requirements other than for communications, etc). "Any of that demand which does

*"Projection of Non-Federal Demand for Space Transportation Services through 2000," AIAA Assessment for the Office of Science and Technology Policy, The White House, 19 January, 1981.

materialize -- and it is the judgment of the contributors (to the AIAA study) that it will -- will further increase the projected gap between the demand for launch services and their availability."

- "This projected supply-demand gap is very likely to be exacerbated by the initial shuttle space transportation system operational problems which are certain to be encountered, as with any new, complex system, based on past experience with similar advanced-technology flight systems. Principal areas of concern are launch rate assurance, which could be adversely affected by orbiter turnaround delays and saturation of launch facilities; orbit transfer limitations due to the need for a suitably high performance upper stage (a subject the AIAA has repeatedly stressed ever since it first assessed the new shuttle space transportation system in 1972); and the economic necessity of maintaining launch schedules for commercial customers."

- "Additional space transportation system capability will be needed to relieve schedule and capacity constraints which appear to be imposed by limited numbers of space shuttle orbiters and mobile launch platforms and by the capacity of certain facilities at the Kennedy Space Center."

- "Steps should be taken immediately to ensure the availability of an adequate supply of expendable launch vehicles to meet the stringent schedule needs of commercial customers until the shuttle space transportation system has fully demonstrated its ability to provide the necessary operational reliability and throughput capacity."

Specific data supporting these statements were presented in the demand projection cited earlier and were summarized in an Astronautics and Aeronautics article, "Case for a Fifth Shuttle and More Expendable Launch Vehicles," attached herewith.

Since the AIAA completed its study, the demand growth has exceeded our projections. The Federal Communications Commission has approved 20 more communications satellites, the Europeans have initiated their L-Sat project, which will evaluate Ka-band (30/20 GHz) communications technology in a major way, and a number of developing nations have initiated or confirmed satellite communications programs. Space processing prospects are considerably more promising than they were a year and a half ago. The escalation of military space activities, particularly those requiring shuttle services, will begin to place even greater demands on the already limited system. The commercial market for space transportation, considered only two years ago to be too risky for private-sector involvement, has since become sufficiently interesting to have spawned at least three serious entrepreneurial enterprises: Arianespace, The Space Transportation Company, and Space Services, Inc.

Hence our conclusions of a year and a half ago are perhaps even more valid then they were then. It is our understanding that the Administration, in recognition of this growth in demand and the consequent need to update its policy on space transportation, is currently reviewing the entire operational and pricing structure of the national space transportation system and is considering a proposed investment

in a fifth orbiter by The Space Transportation Company in exchange for commercial and foreign marketing rights. The AIAA strongly encourages a move toward a new, more realistic pricing structure and maximum involvement of the private Sector commensurate with national security and federal R&D requirements.

With regard to competition by Arianespace, there is no doubt that the lower price, far more favorable terms, and guaranteed launch schedule offered by Arianespace as compared with available US expendable launchers have done much to attract customers, even U.S. companies. In effect, Arianespace makes them an offer they can't refuse. As long as shuttle space availability is constrained, as it will be for at least the next four or five years, Arianespace will siphon off much if not most of the new launch business accompanying the explosive demand growth for commercial space systems. And unless steps are taken today to increase shuttle availability after that initial four or five year phase, the loss of business to Ariane and to the increasing Japanese launch vehicle capability will cripple the shuttle's marketability well into the future. The present situation has been summarized in a fecent Astronautics and Aeronautics article "NASA Jockeys in the Market -- And Feels a Draft," attached herewith.

The major steps which need to be taken have been repeatedly recommended by the AIAA for years:

- Initiate construction of a fifth orbiter, not only for its capacity to meet launch demand but also to keep the production line intact if (or when, according to the January 1981 AIAA projection)

transportation system adequate to support projected traffic demand, incorporating elements to improve the efficiency and reduce the cost of carrying freight and personnel not only from the Earth into orbit but also between various Earth orbits and other trajectories...

"By making a firm commitment to a comprehensive space policy and by taking consistant action to implement its goals, the U.S. can maintain a leading role in many of the space activities in which it has pioneered. Nearly five hundred years after Columbus opened a path to the New World, we can ensure that U.S. leadership in the exploration and utilization of space will bring maximum returns from the 'new world' of space to the nation's citizens and to all the peoples of the world."

Attachments:

(a) Personal resume, Dr. Jerry Grey

(b) "Cas for a Fifth Shuttle and More Expendable Launch Vehicles," Astronautics and Aeronautics, March 1981, pp. 22-26

(c) "NASA Jockeys in the Market -- And Feels a Draft," Astronautics and Aeronautics, June 1982, pp. 11-16

(d) "Space Policy: An AIAA View," May 28, 1982

February 1, 1982

BIOGRAPHY BRIEF FOR DR. JERRY GREY

Dr. Jerry Grey received his Bachelor's degree in Mechanical Engineering and his Master's in Engineering Physics from Cornell University; his PhD in Aeronautics and Mathematics from the California Institute of Technology.

His early career included stints as a full-time Instructor of Thermodynamics at Cornell, an engine development engineer at Fairchild, a Senior Engineer at Marquardt, and a hypersonic aerodynamicist at the GALCIT 5-inch Hypersonic Wind Tunnel. He was a professor in Princeton University's Department of Aerospace and Mechanical Sciences for 15 years, where he taught courses in fluid mechanics, propulsion, and nuclear powerplants and served as Director of the Nuclear Propulsion Research Laboratory. He formed the Greyrad Corporation in 1959 and was its full-time President from 1967 to 1971. He is now senior consultant on Public Policy for the American Institute of Aeronautics and Astronautics and Deputy Secretary General of the United Nations Second Conference on the Exploration and Peaceful Uses of Outer Space. He is also Adjunct Professor of Environmental Science at Long Island University, where he teaches courses on energy, Chairman of the Calprobe Corporation, a supplier of high-temperature instrumentation based on Dr. Grey's patents, and a Director of the Applied Solar Energy Corporation.

Dr. Grey is the author of seven books and over two hundred technical papers in the fields of solar energy, fluid dynamics, heat transfer, rocket and aircraft propulsion and power, plasma diagnostics, instrumentation, and the applications of technology. He has served as consultant to the U.S. Congress (as Chairman of the Office of Technology Assessment's Solar Advisory Panel), the United Nations, NASA, the Department of Energy, and the U.S. Air Force, as well as over twenty industrial organizations and laboratories. He was Vice President Publications of the AIAA for five years and Chairman of the Coordinating Committee on Energy of the American Association of Engineering Societies. He is currently Vice President of the International Astronautical Federation, a Director of the American Astronautical Society, a Director of the Scientists Institute for Public Information, and a member of the Explorer's Club. Dr. Grey is listed in Who's Who in America, American Men of Science, Who's Who in Aviation, Engineers of Distinction, Contemporary Authors, and the United Kingdom's Blue Book and Dictionary of International Biography, and is member of the International Academy of Astronautics. His most recent book, Enterprise, was published by William Morrow and Company in 1979; his next book, Beachheads in Space, will be released by MacMillan in 1982.

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SPACE POLICY

An AIAA View

Prepared by the
AIAA Public Policy Committee

May 28, 1982

American Institute of Aeronautics and Astronautics
1290 Avenue of the Americas, New York, N.Y. 10104 / 212/581-4300

PROLOGUE

The modern world is influenced in every sense by technology. Space activities require some of the most advanced technical innovations and offer some of the most significant benefits. They have brought us much of our present microelectronics capability, as well as more accurate forecasting of weather and natural disasters, low-cost global communication and navigation, and the surveillance from space which is so essential to our national security. Space opens unbounded opportunities for expanding mankind's understanding and utilization of the resources of the universe, and for improving the quality of human life.

The United States' Apollo program, one of mankind's greatest technological achievements, was a true source of pride to our citizens and prestige to our nation. Because it was a civil program, open to the world through television via satellite, its impact was even greater outside this country. Its benefits were extraordinary; indeed, they ranged far beyond most expectations.

Today, more than a decade later, the benefits of the space shuttle are becoming evident. Our challenge, therefore, is to frame space policies and goals that will continue a rational and orderly program of space activities.

THEME

President Reagan said in his inaugural address, "It is time for us to realize that we are too great a nation to limit ourselves to small dreams." He thereby enunciated the theme that our nation is embarked on "a new beginning" to revitalize its economy, strengthen its defense, improve its institutions, reassert technological leadership, and regain national self-esteem.

We believe that the continued exploration, utilization, and development of space is a necessary and integral part of that "new beginning." The AIAA therefore urges the Administration to make a firm recommitment to the principles enunciated in the National Aeronautics and Space Act of 1958, and to U.S. preeminence in space activities. These principles form the cornerstone of the policies and goals we propose herewith

POLICIES

It is the national space policy of the United States to:

- Maintain vital space operations in support of national security under all conditions.
- Assure that space systems are used in the national interest, through maximizing the return on our past investments and developing promising new applications to keep the U.S. competitive with increasingly competent commercial space capabilities overseas.
- Assure concerted and sustained space-program cooperation among the government, industry, and university communities, each fulfilling the role to which it is best suited.
- Have the Federal government

(a) Continue to provide the primary support for space research, exploration, and the development of new and long-range technology, not only in its own laboratories but also in those of the universities and the industry.

(b) Encourage, by cooperation and appropriate incentives, entrepreneurial investment by the private sector in high-risk, high-payoff applied research and development and the applications of space systems and technology to the commercial marketplace.

- Support and encourage international cooperation consistent with the above-stated economic and national security requirements, particularly in space science and exploration.
- Protect the right to travel and operate in space so that the benefits of space accrue to all mankind equitably and economically.

GOALS

The goals of the national space program are to:

- Maintain coordinated and mutually supporting but separately administered civil and military space programs encompassing both long-term and short-term elements.
- Establish a unified military space doctrine having a coherent architecture for maximum effectiveness in defense operations of the U.S. and its allies during periods of peace, crisis, or warfare, and assure enduring access to space systems by all military services and commands.
- Sustain a federal program to achieve the practical utilization of Earth orbit through cooperative efforts with the private sector, including appropriate incentives and a careful balance of entrepreneurial risks and rewards.
- Achieve routine access to space through continued commitment to an operational space transportation system sized to meet both current and projected needs for defense, commercial, science, and foreign users.
- Reduce the cost and improve the efficiency of all space operations, particularly transportation, through the maintenance of an active and sustained program for development of advanced technology and giving attention to emerging problems such as geostationary orbit crowding and the proliferation of space debris.
- Extend man's knowledge by systematic exploration of the Earth and its biosphere, the Moon, and the solar system using unmanned spacecraft and by studying the universe beyond through the use of both unmanned and man-tended Earth-orbiting astronomical observatories.
- Extend man's capability to live and work in space by developing the orbital facilities and support systems necessary for uninterrupted operations in Earth orbit.

ACTIONS

Initial actions to begin the process of accomplishing these goals are:

- Make a firm commitment to a specific national space program plan for the next two decades, identifying schedule milestones for (1) operation and expansion of the space transportation system, (2) national security and civil opera-

tions in Earth orbit, (3) science and exploration, and (4) development of the enabling space technologies.

- Establish programs to develop and implement systems not only to improve surveillance, navigation, and military communications functions, but also to support and assure survivability of U.S. space capability and military ground capability against hostile action.
- Initiate vigorous programs in the enabling technologies which are essential to all space activities, particularly in propulsion, large space structures, power generation, life-support systems, and robotics, to support extended-duration space operations.
- Expand and intensify present efforts to establish specific private-sector incentives for public-service and advanced-technology satellite communication services, Earth observation systems, research in space materials processing, and operation of prototype and demonstration commercial space manufacturing facilities.
- Initiate procedures to determine the optimum operational mode for the space transportation system once it has been fully developed and demonstrated. Such a mode could involve a dedicated federal, semi-federal, or private organization or a restatement of NASA's charter to include such operation. Whatever approach is selected should not erode the important research, technology, and development efforts which are fundamental to all space achievements in the future.
- Continue and expand the evolutionary development of a versatile operational space transportation system adequate to support projected traffic demand, incorporating elements to improve the efficiency and reduce the cost of carrying freight and personnel not only from the Earth into orbit but also between various Earth orbits and other trajectories.
- Establish a specific plan for the next two decades to include (1) a stable program for planetary exploration, (2) investigation of comets and asteroids, (3) reestablishment of lunar exploration activities, (4) continued development of space-based platforms for scientific observation of the Earth, the Sun, the stars, and the Universe, and (5) integration of scientific studies wherever possible in spacecraft or space platforms launched primarily for other purposes.
- Establish a resolute evolutionary program commitment for a manned space facility in low Earth orbit to serve as (1) an operational base for shuttle orbiters and orbital transfer vehicles, (2) an orbital storage, power, and servicing depot, (3) a research laboratory, (4) a construction center, (5) an assembly station for higher Earth orbit missions and outbound deep space flights, (6) a support facility for low-orbit free-flying satellites, and (7) a staging area for the construction and servicing of both commercial and public-service multipurpose geostationary platforms.

By making a firm commitment to a comprehensive space policy and by taking consistent action to implement its goals, the U.S can maintain a leading role in many of the space activities in which it has pioneered. Nearly five hundred years after Columbus opened a path to the New World, we can ensure that U.S. leadership in the exploration and utilization of space will bring maximum returns from the "new world" of space to the nation's citizens and to all the peoples of the world.

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QUESTIONS TO DR. JERRY GREY
EXECUTIVE CONSULTANT, AIAA

1. Do you consider the Space Transportation Company concept practical? How do we implement it and why?

ANSWER:

I am not familiar with the details of the Spacetran proposal, but in principle it appears to be practical. The method by which it could be implemented must be established by NASA to ensure that the government's (and the taxpayers') interests are protected. Implementing a bonafide private-sector participation in space transportation is consistent with both the basic U. S. way of life and the present Administration's clearly stated policies, and would begin the essential process of turning over operational responsibilities from the government to the private-sector, in consonance with the intent of the National Aeronautics & Space Act of 1958.

2. Does NASA have well defined goals that justify an additional orbiter? If Congress does not fund the fifth Space Shuttle, should NASA pursue private financing to guarantee a larger fleet?

ANSWER:

NASA's present goals would not justify an additional orbiter only if currently projected turnaround times are realized and no major accidents occur, as has been documented in the January 19th, 1981 AIAA study, "Projection of Non-Federal Demand for Space Transportation Services through 2000". Whether or not NASA pursues private financing depends entirely on the STS potential for realizing a profit, which in turn depends directly on the growth in demand for space transportation services. The AIAA study concludes that such demand will materialize; clearly Spacetran's proposal indicates that at least one private sector organization also believes that it will.

3. How many orbiters do we need in the STS fleet?

ANSWER:

The size of the STS fleet, as noted above, depends on the demand. The AIAA projection, which includes considerations of potential orbiter turnaround delays, indicates that the presently planned four-orbiter fleet is not sufficient to meet the projected demand, and hence that a fifth orbiter should be ordered to keep the production line open. Whether or not subsequent orbiters are needed will depend on the growth of demand and the actual orbiter turnaround schedules experienced during the next few years. It must also be noted that capacity limitations due to other STS elements and ground facilities need to be considered along with the orbiters, as mentioned both in my testimony and in the above-mentioned AIAA study.

4. In your testimony (page 4) you refer to a "new, more realistic pricing structure". How will this affect the STS ability to compete with the government-subsidized Ariane? Should the U. S. government continue to subsidize STS users?

ANSWER:

By a "realistic pricing structure" I imply not only total price, but also terms of payment. Ariane's price is certainly higher than that charged to commercial shuttle customers, but Arianespace's terms are far more favorable. There are a number of innovative pricing policies which could bring both a higher long-term return to the U. S. taxpayers and still be quite competitive with foreign launch services. One suggestion I have made in the past is simply to charge a royalty on all revenues (or a higher royalty on profits) generated by a customer's satellite, asking him to pay only a small "earnest-money" fee up front. If commercial revenues indeed grow as the AIAA has projected, the total launch-service income would far exceed that obtainable with present pricing policies, and yet the royalty-payment basis would be highly attractive to commercial customers because they would pay only out of revenues or profits.

The existence of a bonafide offer by Spacetran to market commercial launch services at a profit implies that government subsidies are not necessary to sustain a competitive position. However, the exact nature of any NASA/Spacetran agreement would have to be examined in order to verify whether or not indirect or hidden subsidies might still prevail.

5. Some time ago you made a study of launch-vehicle needs (Space Transportation Systems: 1980-2000, an AIAA Assessment). Have your estimates changed?

ANSWER:

That assessment discussed the technology, capabilities, and projected costs of space transportation systems. The needs for launch services were discussed in the abovementioned January 19, 1981 study, "Projection of Non-Federal Demand for Space Transportation Services through 2000". estimates we made in both these publications have not changed.

6. Why isn't the U. S. aerospace industry making bids like the one proposed by Spacetran?

ANSWER:

Several aerospace companies have been interested; a number of them, as you know, are contending for the orbiter processing contract at KSC. It is simply a question of investment economics. If Spacetran is able to demonstrate that there is profit and return on investment to be made, I suspect there will be many other entrants into this type of business.

7. What problems do you foresee for the user with private ownership and marketing of Shuttle cargo space?

ANSWER:

I see no such problems that would be unique to private ownership with either the Arianespace or the Spacetran modes of operation that have been proposed.

Mr. FLIPPO. Very good.

Dr. Grey, thank you very much for your testimony.

Has NASA asked you to participate or asked for your comments in regard to any studies on pricing policy of the Shuttle?

Dr. GREY. No, they have not, not in any formal way. We have offered some suggestions from time to time on an informal basis.

Mr. FLIPPO. Could you comment on any problems that you foresee for the user with private ownership and private marketing of the Shuttle cargo space?

Dr. GREY. If I may limit my response to the commercial user and to the foreign user, I see no problem whatsoever as I understand the offer that has been made to NASA; that is, the commercial user would have no difficulty dealing with a commercial operator.

We see a commercial operator—in effect, Arianespace, although it has not quite taken over—doing very well in terms of the Ariane launch vehicle, and I see no reason why a U.S. commercial operator couldn't do the same.

Mr. FLIPPO. So you consider the Space Transportation Co. concept a practical approach?

Dr. GREY. I haven't seen the specific proposal. As I understand the concept, as it has been presented in the public press, there are obvious legal considerations involved in the relationship between the Federal Government and a private operator.

But from the private operator's point of view, dealing with commercial customers—as long as the Government continues to launch and operate the vehicle, which it would continue to do and there-

fore satisfy certain insurance and other requirements—I see no problems whatsoever.

Mr. FLIPPO. From the civilian side of the house, then, you consider it absolutely essential that a decision in regard to the fifth orbiter be made and be made soon in order to ensure the availability of space on the Shuttle, and you consider the pricing policy of the utmost importance if we are to avoid losing considerable market to Ariane and the Japanese?

Dr. GREY. We said that 1½ years ago, sir, and we still think it is true.

Mr. FLIPPO. Thank you very much, Dr. Grey.

Mr. Hollenbeck.

Mr. HOLLENBECK. I have no questions.

Mr. FLIPPO. Mr. McGrath.

Mr. MCGRATH. You said six, seven, eight, nine. That was an interesting answer to the need for the number of orbiters. How many do you envision and how many do you think we have to have before we get to the point where we are just making them for the sake of making them?

Dr. GREY. Sir, I think the number should be predicated totally on the demand. At the moment, the current demand that we can project realistically certainly calls for a fifth orbiter. But that demand is growing rapidly, expecially if I consider the growth of information services being transmitted by satellite and how that might continue to grow. I wear another hat, sir, as Deputy Secretary General of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space. I see great interest on the part of the developing nations in satellite communications and other activities. If that growth develops as it might over the next few years, there will be a need for a sixth, a seventh, and a eighth orbiter. I don't think we should make the commitment to build them until that demand is evident. The demand that calls for a fifth orbiter is already evident, in our viewpoint.

Mr. MCGRATH. And you are referring to land sensing satellites?

Dr. GREY. I am referring principally to communications, which is the primary demand over the next 10 to 20 years, but the remote sensing and now, with some realistic appraisal, the space processing possibilities are beginning to look as if they will also create some demand toward the 1990's and beyond.

Mr. MCGRATH. Thank you. No further questions.

Mr. FLIPPO. Mr. Winn.

Mr. WINN. Dr. Grey, did you see the Washington Post story today on the release of the OTA report on the technologies that are being developed by other countries, other than the United States, in the space field?

Dr. GREY. I did not see the Washington Post story.

Mr. WINN. But you have seen the report, haven't you?

Dr. GREY. Yes, I was on the advisory committee that helped to write that report.

Mr. WINN. Right. I knew that.

Dr. GREY. Thank you. [Laughter.]

Mr. WINN. Did you agree with that overall philosophy or report? Do you agree with that?

Dr. GREY. With what specific section of the report, sir?

Mr. WINN. Well, the fact that the other countries are either even with us or catching us very quickly. They referred to, of course, France and Japan in the technologies. I am on the OTA board, and I saw the report, and I don't necessarily agree with it, but there are parts of it I agree with.

Dr. GREY. I was just going to say, you stated my view exactly. I don't necessarily agree with all of it. There are parts of it, I think, that are valid. One part that is valid is the concern about the very rapid growth in satellite communications technology, particularly on the part of the Japanese, and now with the new L-Sat European program. I think there is a very good chance that both the Japanese and the Europeans may tend to leapfrog our technological capability, althouth we obviously still retain the bulk of the operational capability in this field.

The other area is in remote sensing. The projected Japanese Earth resources satellite is a very advanced machine. It has synthetic aperture radar for all-weather observations. It has a number of other features that we have not begun to look at for commercial remote sensing activities. The French Spot satellite is a more advanced technology even than our Landsat D in some respects, although not in others. There is a real concern that foreign technology is moving ahead of ours, not so much because the foreign technologists, engineers, and scientists are better than ours, but because they have a good, close cooperation with their government agencies. The foreign governments help to support, much more actively than ours does, the space applications area, especially some of these new capabilities. That is what I worry about.

Mr. WINN. I think we found that out last week. The chairman and I spent almost 2 days with the Japanese science delegation that was here, and even though we shared a lot of philosophies, from a technical standpoint, we did not have that specific group of people included in those discussions, but it is quite obvious that they are enthusiastic and eager and that their government is going to put the money into it that is needed to make Japan certainly a top-notch competitor.

Dr. GREY. Sir, we have some evidence—and I think the best example today is in the random-access memory computer chip game—where the Japanese made a decision some 20 years ago that that was going to be an important field. Their Ministry of International Trade and Industry [MITI], their government group, at that time made a major commitment to a number of companies, supported them, and developed some 700 patents in that field. Last year the Japanese took over 70 percent of the U.S. market in the most advanced random-access memory chip available. That is the thing we have to worry about in the future.

Mr. WINN. Do you think, in the OTA report, that they took into consideration the fifth orbiter and the possibilities that could come from the fifth orbiter?

Dr. GREY. I think that was taken into consideration, sir, but not in a specific way. That report really looked at the applications area rather than at the methodology which would support it. There was a section on transportation, and the assumption was that the Space Shuttle orbiter would be available to handle the necessary transportation services.

Mr. WINN. I probably ought to ask this question to the gentleman who is coming up next from Boeing about why the U.S. aerospace industry has not made bids like the one proposed by SpaceTran.

Dr. GREY. I think you might do better asking both of the next two witnesses that question, sir.

Mr. WINN. Well, I would like to hear your opinion—you are heavily involved in that—and then I will ask them, too.

Dr. GREY. I think there were a number of approaches. In fact, if I may speak for the next witness, I know that at one point Boeing was very interested in activities involving either purchasing an orbiter or taking part in commercial space transportation activities. I don't know what happened to that, but I know that several years ago, one of the Boeing witnesses had published several articles in our magazine discussing this activity, and it was certainly of interest.

I suspect it was simply a matter of economics and looking at the overall picture, determining how much investment was necessary and where the investment would come from. It was simply time for somebody to do it, and somebody now has finally done it. The fact that it was not an aerospace company is not terribly critical. Aerospace companies are not known for their very high return on investment or high percentage of profit. Other companies do much better.

Mr. WINN. Thank you, doctor, and thank you, Mr. Chairman.

Mr. FLIPPO. Thank you very much.

Dr. Grey, I wonder, you mentioned the success of the Japanese in identifying an area and seizing upon that opportunity. Would you suggest that the United States perhaps should have a more formalized structure than we currently have to identify sunrise industries of that type?

Dr. GREY. Sir, in the space area, at least, that is one of NASA's specific missions. NASA's job is research and development. It is the development of new technology which, in the long run, will turn into effective and important economic industries.

We have seen a prime example of that in the communications satellite industry. NASA invested perhaps $1 billion over the years 1962 to 1973, and now we have a gross national product coming in from satellite communications which is well above that amount every year. If NASA pursues its R. & D. function as such, this would be a very good approach.

Mr. FLIPPO. What about in nonaerospace areas? Would you suggest a more formalized structure to handle other areas of science and technology?

Dr. GREY. Again, we have a number of agenices within our administration whose purpose it is to do that, our Department of Commerce, for example. Whether it does that as effectively as, for example, the Japanese MITI do, I am not prepared to say.

Mr. FLIPPO. Thank you very much, doctor, for your testimony. I appreciate it very much. Thank you for being with us.

Our next witness will be Dr. Robert L. Brock, who is vice president and deputy for strategy planning and acquisition of the Space and Information Systems of the Boeing Aerospace Co.

He is accompanied by Mr. Gilbert Keyes, who is the director of international space sales of the Boeing Aerospace Co.

Gentlemen, it is a pleasure to have you with us. Please feel free to summarize, since the hour is late, and we might have an opportunity to raise a question or two.

Thank you very much for being with us. Please proceed.

STATEMENT OF DR. ROBERT L. BROCK, VICE PRESIDENT AND DEPUTY FOR STRATEGY PLANNING AND ACQUISITION, ACCOMPANIED BY GILBERT W. KEYES, DIRECTOR, INTERNATIONAL SPACE SALES, BOEING AEROSPACE CO.

Dr. BROCK. Thank you, Mr. Chairman.

The Boeing Co. appreciates the opportunity to participate in this hearing on the need for additional Space Shuttle orbiters, and I will try to summarize as briefly as I can.

Specifically, we have been asked to testify whether additional orbiters are required for an effective space transportation system, on the feasibility of the private sector purchasing a fifth orbiter, and on the results of a study that my company has conducted on the proposed private operation of the Space Shuttle system.

Now, let me begin with our conclusions. First, we believe that a fifth orbiter will be needed if the space transportation system is to proceed logically to the point where it is economically attractive to the commercial users who are needed to assure its success.

Second, it is feasible for the private sector to buy the fifth orbiter, as long as there are adequate safeguards both for the organization which purchases it and for the public which will depend upon it.

Finally, Boeing's study showed us, at least, that private operation of the Space Shuttle system can be commercially rewarding, but data to support this conclusion are, at this moment, not conclusive.

Now, briefly on the background, the National Aeronautics and Space Administration commissioned studies in 1977 of alternative methods of Shuttle operations. Private operation of the orbiters was one of these alternatives.

In early 1978, we met with Government and industry officials to discuss the feasibility of what we called Shuttle commercialization. Later in 1978, then, we met with other aerospace firms, and during the second half of that year we spent developing operations models and analyzing the financial aspects of this private enterprise approach. In January 1979, we completed our efforts in this direction.

The study objective was to investigate in a preliminary way the attractiveness of Space Shuttle operations as a business venture. We wanted to find out basically; what the best approach was, how much investment might be required, what return could be expected, and what risks were involved.

We looked at three different approaches. In the first, the company formed would have the franchise for all planned Space Shuttle launches. In the second, its responsibilities would embrace all nonmilitary launches but would include all other Government missions. In the third, the proposed company would be limited to the franchise for all commercial and foreign launches only.

In each case, it was assumed that the proposed company would purchase a fifth orbiter. Our assessment included calculations of potential return on investment, cash flows, yearly profit-and-loss statements, and a preliminary risk assessment. This preliminary risk assessment consisted of sensitivity studies showing the effect of reduced traffic, increased expenses, increased orbiter operating costs, and changing Shuttle fares.

Our assumptions for the study included acceptance of the published NASA traffic models and pricing policies, the published NASA expenses, and a franchise limited to 10 years.

Using all these assumptions, the three options each showed an attractive return on investment. It was concluded, however, that it would take an unacceptable length of time for a new company to break even, even if it assumed the entire Shuttle operation.

It was also concluded by our study that a consortium approach would be needed. There were three reasons for this, basically: We felt it would be politically unacceptable for a single company to be granted the fruits of years of public efforts and billions of taxpayer dollars. Second, the necessary investment was too great for one existing company. Third, the financial risks were too great for one company to assume.

Now, this brought us to the point in our study at which we believed that private operation of the Shuttle had a great promise of profitability, but—I must accent this—only if our assumptions were valid. Again, those assumptions were using the 1977–78 traffic forecasts and pricing policies that NASA had developed, and it included the forecast for operations costs and also the assumption that the yet-to-be-flown Space Shuttle would meet its objectives including turnaround times, orbiter costs, load factors, and the like.

The profit-to-investment lines that came out of the study looked very rewarding based on these assumptions, but their direction was greatly lowered by relatively small negative changes in the NASA projections.

For instance, if you take the case of the proposed company with responsibility for all Shuttle flights, if the assumptions were accurate, there would be a 30-percent return on investment, according to this simple study we made; but if Shuttle operations costs increased only 20 percent, the forecast return would drop to 10 percent, and that is with all the other NASA assumptions holding firm.

So in January 1979, we concluded that the risks—and I would have to accentuate the time of 1979—were too great. The Shuttle had yet to fly, and operational data therefore were nonexistent. It was simply too early in the Shuttle program.

Boeing terminated the study at that time, but we are still vitally involved in the space program. I would like to make a couple of other comments here relative to the fact that we are the developer and builder of the Space Shuttle's inertial upper stage, which is a product that we believe relates directly to the number of orbiters in the Shuttle system.

The IUS in many ways mirrors the Shuttle. Its development has been long and difficult, and it has pushed the state of the art more than any of us first imagined. However, these initial development difficulties are behind us. All test data are excellent, and they fore-

cast a vehicle system with a reliability of more than 98 percent, which is far greater than any other previous unmanned stage.

The IUS-Shuttle combination will provide a launch system which, through much of this decade, could capture a major share of the world's space transportation market. Technically, it can meet and beat the competition. For instance, the Shuttle-launched IUS can carry better than 5,000 pounds to geosynchronous orbit, compared to the new Ariane 4, which will be able to insert about 4,200 pounds into this orbit in 1985.

We are already looking at ways of producing a less expensive commercial version of the IUS which could cost in the range of $20 to $25 million in 1985 dollars. This vehicle would meet the demands of both performance and cost of many of the prospective commercial users, and we see its need worldwide.

We have not yet secured permission from the Air Force or State Department for such a development. However, it may very well be allowed, since this commercial IUS would be built in an American plant, handled by American technicians and flown in the U.S. Shuttle. In other words, it need not ever leave home until it leaves for space.

A major impediment to this development is the uncertainty of the Shuttle payload costs. If the IUS-Shuttle combination costs the same or less per pound of payload as Ariane 4, then there may be a very large market. If the cost is significantly higher, we could very well lose out to the European launch vehicle.

In summation, we at Boeing know that we must be a leader in space if we are to be commercially dynamic as we turn into the 21st century, and the United States must be a leader in space if it expects to be a continuing world force.

We all must vigorously promote the commercialization of space, whether it be through private operation of the Shuttle by something like space transportation or by other means which keeps the cost competitive.

This is only the beginning. The space transportation system is the first step, somewhat like the introduction of air flight. At first people questioned the need for commercial airliners, but today would anyone in this room trade an airliner for a train ride across the country?

I think that summarizes mostly what we have, and again I thank you for this opportunity to testify and would be happy to answer any questions we can.

[The prepared statement, plus answers to questions asked of Dr. Brock follow:]

Testimony of

Dr. Robert L. Brock, Vice President
and Deputy for Strategy Planning & Acquisition
Space and Information Systems
Boeing Aerospace Company

Before the

Subcommittee on Space Science and Applications
Committee on Science and Technology
U.S. House of Representatives

June 15, 1982

The Boeing Company appreciates the opportunity to participate in this hearing on the need for additional space shuttle orbiters.

I am Dr. Robert L. Brock, Vice President and Deputy for Strategy Planning & Acquisition for the Boeing Aerospace Company's Space and Information Systems division. As such, it is my responsibility to look to the future of the Space Shuttle and assess its affect on our future business.

Specificially, I have been asked to testify whether additional orbiters are required for an effective Space Transportation System; on the feasibility of the private sector purchasing a fifth orbiter, and on the results of a study my company has conducted on the proposed private operation of the space shuttle system.

This is exactly what I will do. But, to avoid the cliffhanger approach, let me begin with our conclusions:

First, we believe that a fifth orbiter will be needed if the Space Transportation System is to procede logically to the point where it is economically attractive to the commercial users who are needed to assure its success.

Secondly, it is feasible for the private sector to buy the fifth orbiter--as long as there are adequate safeguards both for the organization which purchases it and for the public which will depend upon it.

And, finally, Boeing's study showed -- to us, at least -- that private operation of the Space Shuttle system can be commercially rewarding, but data to support this conclusion are, at this moment, not conclusive.

Now, the background. It is Boeing's obligation to look at all opportunities for new business, both in the short term and in the long. Private operation of the shuttle was one such investigation.

In 1977, the National Aeronautics and Space Administration commissioned studies of alternative methods of shuttle operations. Private operation of the orbiters was one of these alternatives and, early in 1978, we met with government and industry officials to discuss the feasibility of what we call "Shuttle Commercialization."

This led, in later 1978, to our meeting with other aerospace firms to consider what might be called a "Comsat approach" -- or consortium -- for shuttle operations. The second half of that year was spent on developing operations models and analysing the financial aspects of this private enterprise approach.

And, in January 1979, we completed our efforts in this direction.

The Boeing study was built as part of our space organization's long-range business planning and, as such, was rather simplistic. Its objective was to investigate, in a preliminary way, the attractiveness of space shuttle operations as a business venture. We wanted to find out, basically, what the best approach was, how much investment might be required, what return could be expected, and what risk was involved.

We chose three approaches for evaluation:

In the first, the company formed would have the franchise for all planned space shuttle launches. In the second, its responsibility would embrace all non-military launches but would include all other government missions. In the third, the proposed company would be limited to the franchise for all commercial and foreign launches only.

In each case, it was assumed that the proposed company would purchase a fifth orbiter. The company would receive a time-limited franchise for the space launch responsibility it had assumed.

Our assessment included calculations of potential return on investment, cash flows, yearly profit-and-loss statements and a preliminary risk assessment. This preliminary risk assessment consisted of sensitivity studies showing the effect of reduced traffic, increased expenses, increased orbiter costs and changing shuttle fares.

Our assumptions for the study included acceptance of the published NASA traffic models and pricing policies, published NASA expenses, and a franchise limited to 10 years.

Using all these assumptions, all three options showed an attractive return on investment. It was concluded, however, that it would take an unacceptable length of time for a new company to break even if it assumed the entire shuttle operation.

It also was concluded that a consortium approach would be needed. There were three reasons:

1. We felt it would be politically unacceptable for a single company to be granted the fruits of years of public efforts and billions of taxpayer dollars.
2. The necessary investment was too great for one existing company.
3. The financial risk was too great for one company to assume.

This brings us to the point in our study at which we believed that private operation of the shuttle had a great promise of profitability but -- and I must accent this -- if our assumptions were valid.

Let's take another look at those assumptions:

1. That NASA's 1977-78 traffic forecast and pricing policy were accurate.
2. That NASA's 1977-78 forecast operations costs were correct.
3. That the yet-to-be flown space shuttle would meet its objectives, including turn-around times, orbiter costs, load factors, and the like.

Our profit-to-investment lines looked very rewarding based on the assumptions. But their direction was greatly lowered by relatively small negative changes in the NASA projections.

For instance, take the case of the proposed company with responsibility for all shuttle flights. If all the assumptions were accurate, there would be a 30 percent return on investment, according to our simple study. But, if shuttle operations costs increased only 20 percent, the forecast return would drop to 10 percent -- and that's with all the other NASA 1977-78 estimates holding in line.

So, in January 1979 we concluded that the risks -- and I accent at that time -- were too great. The shuttle had yet to fly and operational data, therefore, were nonexistent. It was too early.

All this does not mean that I or my company do not believe in the commercial operation of the shuttle. Far from it. The concept is alive and well.

Dr. Klaus Heiss and Space Transportation Company continue to pursue the concept of a privately operated shuttle. And Dr. Heiss is a longtime Boeing consultant who participated with us in our study. We wish him and Space Transportation well.

Boeing may have terminated its study, but it still is vitally involved in space. It is our heritage.

It was Boeing Lunar Orbiters which mapped the Apollo landing sites. We built the S-1C first stage of the Saturn 5 and were integrator of the entire Saturn 5 stack. We built the Lunar Rovers and managed the Apollo TIE, or Technical Integration and Evaluation program. We were contractor for Mariner 10, built the Applications Explorer Missions platforms, and now are involved in small space platforms, space operations center and orbital transfer vehicle studies, and other NASA and military space work.

Very importantly, we are the developer and builder of the space shuttle's Inertial Upper Stage, a product which relates directly to the number of orbiters in the shuttle system.

The IUS, in many ways, mirrors the shuttle. Its development has been long and difficult. It has pushed the state of the art, more so than we first imagined. However, these initial developmental difficulties are behind us. All test data are excellent and they forecast a vehicle system with a reliability of more than 98 percent, far greater than any previous unmanned stage.

The first Shuttle IUS was rolled out in our Boeing Space Center just 12 days ago and is about to be shipped to the Cape for preparation for a January launch. Another IUS is in Florida, at the Air Force's Eastern Launch Site, readying for a September launch as the upper stage of a Titan-34D.

The IUS-shuttle combination will provide a launch system which, through much of this decade, could capture a major share of the world's space transportation. market. Technically, it can meet -- and beat -- the competition. For instance, the shuttle-launched IUS can carry better than 5,000 pounds to geosynchronous orbit, compared to the new Ariane 4, which will be able to insert about 4,200 pounds into this orbit in 1985.

We are already looking at ways of producing a less expensive commercial version of the IUS, which could cost in the range of 20 to 25 million in 1985 dollars. This vehicle would meet the demands of both performance and cost of many of the prospective commercial users. We see its need worldwide.

We have not yet secured permission from the Air Force or State Department for such a development. However, it may very well be allowed, since this commercial IUS would be built in an American plant, handled by American technicians and flown in the U.S. shuttle. In other words, it need not ever leave home until it leaves for space.

A major impediment to this development is the uncertainty of shuttle payload costs. If the IUS-shuttle combination costs the same or less per pound of payload as Ariane 4, there may be a very large market. If the cost is significantly higher, we very well could lose out to the European launch vehicle.

Thus, not only is Boeing dependent on a commercially viable shuttle, so is the nation. And if the shuttle is commercially viable, the question of a fifth orbiter will be moot. The question may well be whether we need a sixth, or seventh, or more.

In summation, we at Boeing know that we must be a leader in space if we are to be commercially dynamic as we turn into the 21st Century. And the United States must be the leader in space if it expects to be a continuing world force.

We all must vigorously promote the commercialization of space, whether it be through private operation of the shuttle by something like Space Transportation, or by other means which keep costs competitive.

This is only the beginning. The Space Transportation System is the first step, somewhat like the introduction of air flight. At first people questioned the need for commercial airliners but, today, would anyone in this room trade an airliner for a train ride across country?

Congress could do well by seeing that the necessary operational data for the shuttle are developed and made available. Then all you need do is stand back. Nobody need tell private enterprise what to do. It's our job, and we're ready -- whether it be through a fully private operation or within a partnership between government and industry.

Again, thank you for this opportunity to testify.

I have with me Gil Keyes, director of international space sales for my organization and, more importantly, the person who headed up our shuttle commercialization study. Gil also is responsible for the marketing of our MESA small space platform which will be carried by Ariane -- so he knows the shuttle's competition.

Do you have any questions?

Boeing Aerospace Company's

Response to Questions for the Record

1. Question:

Do you consider the Space Tran concept practical? Is it too soon to implement such a proposal? When is the best time to do this?

Answer:

The Space Tran concept appears practical assuming that they have adequate financing. It is our belief that demand will exceed space launch capability in the later 1980's, so we believe their added shuttle capacity will be needed.

The time from start of negotiations to availability of the fifth orbiter should be several years, thus, the Space Tran proposal should be implemented as soon as possible.

2. Question:

How has the attitude regarding space changed since the late 1970's, when Boeing studied private STS ownership and operation and decided it was impractical, to the early 1980's where Space Tran has proposed to purchase the fifth orbiter in exchange for exclusive marketing rights of all commercial and foreign payloads?

Answer:

It appears to us that the "national" attitude toward space between the late 1970's and today has changed in several ways.

a. There is less Administration support for large national space science projects.

b. There is more pressure for private sector funding of space projects.

c. There is an increased public desire to make our big space investments "pay off" in increased space products and services.

d. We believe that there is a stronger public feeling that America's investment in the shuttle was a good investment.

Boeing Aerospace Company's

Response to Questions for the Record

3. Question:

How are the Boeing concepts different from the Space Tran proposal? How are they similar?

Answer:

The Boeing concept envisioned private sector assumption of a given segment of the market on a franchise basis for a limited period of time. As we understand it, Space Tran would simply buy an orbiter and sell to all segments of the market.

Both concepts included the purchase by the private sector of a fifth orbiter.

4. Question:

Do we need a company like Space Tran to effectively market the reusable STS?

Answer:

Boeing believes that a private company can more effectively market the reusable STS than a Government agency. We believe that Space Tran would be more motivated and aggressive in keeping the fifth orbiter fully utilized.

Boeing Aerospace Company's

Response to Questions for the Record

5. Question:

Can the Space Shuttle effectively compete with Ariane?

Answer:

Effective shuttle competition is based on price, terms, and reliability of launch as well as ability to carry larger loads.

The flexibility of shuttle operation makes it attractive. Payloads can be checked out in orbit before release.

However, the bottom line is the cost per pound in the desired orbit, and this has to be no higher than Ariane if the shuttle is to be competitive.

6. Question:

Did your study show you what the orbiter fleet size should be? What size did you consider?

Answer:

The Boeing study simply used the NASA mission model and orbiter fleet size in determining economic feasibility. Independent evaluation of fleet size was not made.

Boeing Aerospace Company's

Response to Questions for the Record

7. Question:

Does the proposed Shuttle Processing Contract, which turns over Shuttle processing to an individual contractor or consortium, fit into the appropriate timeline in which the private sector will take over Shuttle operations? Kennedy Space Center personnel believe that the SPC should be in place by STS-10, is this soon?

Answer:

It would appear desirable to have a stable shuttle operational mode in place before the start of a private operation such as Space Tran. Thus, the current NASA plan for the Shuttle Processing Contract does not appear to be too soon, with respect to Space Tran operation.

8. Question:

Since Space Tran has the financial backing for the fifth orbiter, and we agree that we need it, but Government funding is still questionable, should we allow Space Trans to buy the orbiter in order to guarantee an adequate fleet size to handle the projected space traffic for the late 1980's?

Answer:

If Space Tran has adequate financing, it would appear to be in the best interests of the United States to allow their purchase of the fifth orbiter now. The extra capacity and, hopefully, aggressive marketing could contribute to the maintenance of U.S. leadership in space.

Boeing Aerospace Company's

Response to Questions for the Record

9. Question:

Would Boeing like to purchase the fifth orbiter? How about if Space Tran buys the fifth orbiter, would Boeing buy a sixth orbiter to compete with STC in Space Shuttle payload marketing?

Answer:

As indicated in our testimony, considerable additional study would be required to answer that question. We currently have no plans to initiate such a study.

Mr. FLIPPO. Thank you very much, Dr. Brock.

At this time, do you believe that it is timely to implement a proposal such as the space transportation concept?

Dr. BROCK. I guess I would have to answer that by saying that following our initial study we have not been following closely the Space Shuttle activities. I think again it would depend upon a review of the considerations that I mentioned earlier.

Mr. FLIPPO. Dr. Brock, do we need a private company to effectively market the reusable Shuttle? Do you think that is the most effective method?

Dr. BROCK. I think it is a method that can be effective if you can overcome the other factors that are involved, some of which have been alluded to here earlier, the DOD missions and that sort of thing. I think that a private company, if the risks are acceptable, may get a fair return on their investment. The aggressiveness of private companies would have to be an asset in this type of marketing activity for the commercial utilization.

Mr. FLIPPO. Mr. Keyes, I noted that you have responsibility for international space sales with Boeing Aerospace. Do you find much interest in the foreign community to fly on Shuttle or to utilize these facilities?

Mr. KEYES. Yes, Mr. Chairman, I do. The key issue is one of timing, making sure that the payloads can get up on schedule and within cost.

If we can have a price per pound in orbit for the Shuttle competitive with Ariane and with the capability of lifting over 5,000 pounds with the IUS-Shuttle combination, I think we can be extremely competitive.

Mr. FLIPPO. So you think the Shuttle can effectively compete with Ariane?

Mr. KEYES. Yes, sir.

Mr. FLIPPO. The Ariane, it is alleged, is a subsidized system. The U.S. pricing policy then, in order for us to be competitive with Ariane, would not meet full cost. Would you agree with that?

Mr. KEYES. I cannot answer that question, We would have to have a comparison of costs, which we just do not right at the moment.

Mr. FLIPPO. Would it be logical to assume that a pricing policy that would be competitive with Ariane would not recover full costs, operational costs?

Mr. KEYES. That is a tough one, Mr. Chairman. It seems to me that every foreign payload that we bring into this country and we fly on the Shuttle, recovers dollars into the Treasury because of income tax and corporate taxes.

Mr. FLIPPO. I am really trying to get some advice as to how we in the Congress ought to view this pricing mechanism. That is really the import of my question.

Mr. MCGRATH. Will the chairman yield?

Mr. FLIPPO. Yes, I would certainly yield.

Mr. MCGRATH. Were you aware of the new pricing policy announced by NASA this morning?

Mr. FLIPPO. I will be glad to yield to the gentleman to explain that if he would like.

Mr. MCGRATH. I understand that a new pricing policy was announced this morning at a press conference that I was not aware of, and I was wondering whether the chairman knew.

Mr. FLIPPO. No, it has not been brought to my attention at this point.

But you think that, or would you suggest that a pricing policy that would not recover full costs could conceivably be in the interest of the United States?

Mr. KEYES. Yes, sir, you would have to do a study of what kind of return you would get, but I think, absolutely, we should be making the Shuttle competitive over the next several years.

Mr. FLIPPO. Mr. Hollenbeck.

Mr. HOLLENBECK. Are you familiar, Dr. Brock, with the basic concepts of the SpaceTran proposal?

Dr. BROCK. No, as a matter of fact, I am not.

Mr. HOLLENBECK. I was going to ask you, what did you consider the risks at the time of your company becoming involved with purchasing the fifth orbiter and/or operating the Shuttle system?

Dr. BROCK. Well, the risks that we saw as predominant at that time were the risk of a catastrophic loss and the the risk of third-party liability. The third risk was basically tied to the uncertainties in the data available for forecasting. It looked like a pretty high risk based on that degree of uncertainty of profit for quite a long period of time. That was the one risk we really couldn't handle at that time.

Mr. HOLLENBECK. And now we have more accurate data than we had in 1979.

Dr. BROCK. Now you have more data, certainly, than we had in 1979.

Mr. HOLLENBECK. Did you have any concern with the DOD involvement and possibly bumping of commercial users?

Dr. BROCK. We didn't look into that aspect, although, Gil, you may want to comment. Gil conducted the study.

Mr. HOLLENBECK. Or even the DOD becoming involved itself in purchasing another orbiter or orbiters and thus having a conflict there, a contractual problem and an actual conflict.

Mr. KEYES. Mr. Hollenbeck, we really did not get into that degree of depth. We just took the first cut to see whether it looked like it could be a possible profitable operation.

Mr. FLIPPO. Mr. McGrath.

Mr. MCGRATH. Dr. Brock, you have sort of hit the nail on the head as far as I am concerned with one of the problems of private entrepreneurialship of marketing the Space Shuttle cargoes, and that simply is the liability of the Government, the liability of the company, and the third-party liability. Have you taken a look or done any kind of study, any research into what kind of insurance premiums would be required in order to effect full cargo of the Space Shuttle, naturally depending on the cargo, but what kind of ball park figures are we talking about?

Dr. BROCK. I don't think I could answer that in terms of the actual costs. When we made the study, we concluded that you probably could get coverage for those things, but it would be a reasonably complex situation. A great deal of progress is being made in

insurance relative to space endeavors; however, it still is relatively new ground and you don't have the whole set of data to go on.

Mr. MCGRATH. Well, you would not be aware, then, that there are certain State laws which would prohibit certain insurance companies from entering that kind of a market?

Dr. BROCK. No, sir, I would not.

Mr. MCGRATH. Thank you.

Mr. FLIPPO. Mr. Winn.

Mr. WINN. Thank you, Mr. Chairman.

Dr. Brock, in your study or in the Boeing study, did you show what the orbiter fleet size should be? Either one of you can answer.

Dr. BROCK. Gil, I think you can answer it.

Mr. WINN. And what size did you consider?

Mr. KEYES. We considered a five-orbiter fleet. In fact, we did not even consider the possibility of a four-orbiter fleet.

Mr. WINN. Well, would Boeing buy the fifth orbiter now?

Mr. KEYES. You answer that. [Laughter.]

Dr. BROCK. No, sir.

Mr. WINN. You have to talk to Mr. Wilson about this.

Dr. BROCK. Yes, I have to talk to Mr. Wilson, you are right. But I think, seriously, the viability of any company going into a prospective arrangement like that of purchasing an orbiter would require a considerably more indepth study than we did in 1979. The data would have to be of a much more certain nature or else we could not make a sound recommendation to the board of directors that the risks were acceptable with potential return and the time of return on investment.

Mr. WINN. Are you updating your study now at this present time?

Dr. BROCK. No, sir, not at the present time.

Mr. WINN. I gather that you figure there are still a lot of unanswered questions. So my next question was going to be that if SpaceTran bought the fifth orbiter, would you be prepared to buy the sixth orbiter? I am not trying to sell it, you know.

Dr. BROCK. Well, if SpaceTran bought the fifth orbiter and a time period elapsed between their procurement of the fifth orbiter and operating the fifth orbiter, and if their operational margins looked like they were reasonable, I guess we might consider a serious study of a business venture beyond that point.

But you would have to again have more certainty in the data.

Mr. WINN. Without delving into Boeing's financial problems, do you think that if SpaceTran or someone else bought the fifth orbiter, Boeing would set aside enough funding to continue the study as to the possibility of a purchase in the future?

Dr. BROCK. Yes; I think Boeing is in the transportation business. That is our business, and I think that if another private industry or enterprise moved ahead and bought a fifth orbiter we most certainly would take another hard look at the business aspects of that area, to stay abreast of the entire transportation field.

Mr. WINN. But there are no plans to do it right now on the board?

Dr. BROCK. There are no plans at the present time.

Mr. WINN. Thank you very much.

Thank you, Mr. Chairman.

Mr. FLIPPO. The gentleman from New York?

Mr. MCGRATH. Would you consider that sixth orbiter if you knew that you wouldn't be able to market any of the five existing?

Dr. BROCK. Well——

Mr. MCGRATH. If there were five orbiters and you would buy the sixth one, and the deal for the fifth one was to market all of them, would you buy one in order to market just one?

Dr. BROCK. We would have to study that. On the surface, I don't think that would be a viable situation. I would have to say I think not.

Mr. MCGRATH. Thank you.

Mr. FLIPPO. Dr. Brock, thank you very much, and Mr. Keyes. We appreciate your testimony very much.

Dr. BROCK. Thank you, Mr. Chairman.

Mr. FLIPPO. Our final witness for today is Dr. Klaus Heiss, president of the Space Transportation Co., Inc. He is accompanied by Mr. William S. Field, of the Space Transportation Co. board and senior vice president of the capital markets department, Prudential Insurance Co. of America.

You might introduce the other gentleman accompanying you. Please feel free to summarize your statement so that we might have adequate time for questions.

Thank you very much.

STATEMENT OF DR. KLAUS P. HEISS, PRESIDENT, SPACE TRANSPORTATION CO., INC., ACCOMPANIED BY WILLIAM S. FIELD, C.L.U., SPACE TRANSPORTATION BOARD AND SENIOR VICE PRESIDENT, CAPITAL MARKETS DEPARTMENT, PRUDENTIAL INSURANCE CO. OF AMERICA, INC.; PAUL G. DEMBLING, SCHNADER, HARRISON, SEGAL & LEWIS; AND DELBERT D. SMITH, SCHNADER, HARRISON, SEGAL & LEWIS

Dr. HEISS. Mr. Chairman, I have with me, in addition to Mr. Field, Mr. Paul Dembling and Delbert Smith, both partners in the law firm of Schnader, Harrison, Segal & Lewis.

I will summarize the key points of our written statement.

The Space Transportation Co., SpaceTran, was formed in 1979 for the purpose of determining whether the private ownership and operation of a fifth orbiter would be economically feasible. Earlier this year, we were joined in our effort by Prudential. Mr. Field will testify briefly later on.

The broad question before this committee, I believe, should not be limited to the need for the fifth orbiter; the real question before the Nation is at what rate to procure new orbiters in order to build upon the splendid accomplishments of the orbiter *Columbia* to date.

Briefly, you do not develop a transportation system, produce four units, and then shut down that capability for the next 20 years. Specifically, however, on orbiter five, the key items are:

One, the ability to meet the growth in demand for commercial and foreign users.

Two, the assurance that the United States can compete effectively with Arianespace and other foreign launch systems.

Three, it has to be a hedge against catastrophic losses and operational difficulties of the first four orbiters. We have to look at such events seriously.

Fourth, increased presence of U.S. aerospace capabilities in world markets and the improvement of the balance of payments of this Nation.

And, finally, the fifth orbiter is needed for more cost-effective Shuttle operations.

I am skipping several points. However, I would like to point out that the example set by the Europeans in creating Arianespace, a private company, with business incentives, objectives, and techniques, has been singularly successful. We believe that SpaceTran, under private ownership, with substantial capital at risk, can match the marketing effort of Arianespace or any other foreign competition.

As to our specific proposal, the general key items are: First, SpaceTran proposes to purchase Orbiter V with private funds raised in the United States.

Second, to contract for all commercial and foreign users of Orbiter V, not the fleet.

Third, to contract with NASA for launch support services.

Fourth, to make Orbiter V available to the Department of Defense whenever an emergency use of Orbiter V is required for reasons of national security.

Under our proposal, submitted in May, SpaceTran does not seek from NASA any exclusive arrangement to fund additional orbiters or to market commercial and foreign payloads.

Now, let me go to the broader issues of our initiative. We believe that our initiative clearly reflects the intent and purpose expressed in the National Aeronautics and Space Administration Act of 1958, which established a civilian agency so that "activities in space should be devoted to the peaceful purposes for the benefit of mankind." While the 1958 act also recognized military requirements, we submit that national security and free enterprise in space can go hand in hand.

Continued Federal funding of research and development is required if this Nation is to maintain its role as "a leader in aeronautics and space technology," called for in the NASA Act of 1958. There are great new opportunites in this arena through the development of orbital transfer vehicles, large platforms, and the permanent presence of man in space in low Earth orbit. The record of the past testimonies before this committee on the path and scope of space industrialization is witness to these opportunities.

While the private sector cannot provide financial support for these opportunities at this time, SpaceTran believes that this initiative could provide a model for future private endeavors across the board. In the next decades, few areas of U.S. enterprise can be as successful as the commercial development of space if this endeavor is allowed to develop within the context of free world markets. We believe our proposal is the first significant step in that direction, and we are asking your help and encouragement in aiding this venture to a successful conclusion.

Thank you.

[The prepared statement of Dr. Heiss follows:]

STATEMENT OF

KLAUS P. HEISS

PRESIDENT

THE SPACE TRANSPORTATION COMPANY INC.

BEFORE

THE SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

JUNE 15, 1982

Mr. Chairman and Members of the Committee:

My name is Klaus P. Heiss. I am President of The Space Transportation Company Inc. of Princeton, New Jersey. Appearing with me are William S. Field, Senior Vice President of The Prudential Insurance Company of America, and Paul G. Dembling and Delbert D. Smith, partners in the law firm of Schnader, Harrison, Segal & Lewis

Our prepared testimony consists of my short statement to be followed by a brief statement by Mr. Field.

I am pleased to appear before you today to discuss the need for Orbiter V and SpaceTran's proposal to buy the Orbiter to service commercial and foreign users of the U.S. Space Transportation System.

SpaceTran was formed in 1979 for the purpose of determining whether the private ownership and operation of a fifth Orbiter would be economically feasible. Earlier this year we were joined by Prudential in this endeavor. While our studies are not complete, it seems clear at this point that conceptually private ownership of Orbiter V is feasible. The first step in moving from concept to reality is to determine if a Cooperative Agreement with NASA can be worked out under terms and conditions that are suitable to both NASA and SpaceTran.

The key question under consideration however, is not whether the SpaceTran proposal is feasible. Rather the key question is whether a fifth Orbiter makes sense for the U.S. Space Transportation System.

I believe the question should not be one of a fifth Orbiter, but instead at what rate to procure new Orbiters in order to build upon the splendid technological accomplishments demonstrated by Columbia in its first three flights. A gradual, evolutionary upgrading of Space Shuttle capabilities toward a fully reusable system over the next two decades is warranted. This Nation would be remiss if it did not fully utilize the resources and capabilities of the space shuttle system which has had so successful a start.

We believe that a fifth Oribiter, and succeeding ones will produce a number of important benefits.

Among them are:

- First, the ability to meet the growth in demand for for commercial and foreign users;
- Second, the assurance that the United States can compete effectively with Arianespace;
- Third, a hedge against any catastrophic losses or operational difficulties of the first four Orbiters;
- Fourth, an increased presence of United States aerospace capabilities in world markets and an improvement of the Nation's balance of payments; and
- Fifth, more cost effective shuttle operations due to technological improvements in Orbiter V and subsequent Orbiters.

While SpaceTran supports funding of additional Orbiters by the Congress, we believe that private funding of Orbiter V is conceptually possible under the terms and conditions we have proposed to NASA. The following considerations argue in favor of private funding:

First, if a project or activity can be funded by the private sector rather than through the use of taxpayers' funds, there appears to be a consensus today, in view of large Federal budget deficits, that private funding is preferred.

Second, private funding of this magnitude in space transportation would be proof of the maturation of the United States space effort as a prelude to the commercial development of space and space technology. In our opinion, the introduction of private capital to supplement Government funding is critical to sustain space industrialization.

Third, private funding of Orbiter V would facilitate potential private financing of additional Orbiters for commercial and foreign uses, or for that matter, of any other components of the Space Transportation System.

Fourth, the example set by the Europeans in creating Arianespace - a private company with business incentives, objectives, and techniques - has been singularly successful. We believe that SpaceTran, under private ownership with substantial capital at risk, can match the marketing efforts of Arianespace, or other foreign competition.

Our ability to meet the Arianespace challenge depends upon the flexibility afforded by business enterprise to meet

rapidly changing customer needs in the competitive marketplace. For example, it is essential to be able to offer a range of launch financing alternatives for different customers and users, particularly in developing countries. SpaceTran would have these abilities.

On February 8, 1982, SpaceTran submitted a proposal to NASA concerning the private funding of Orbiter V. Subsequent consideration and discussions led SpaceTran to submit a revised proposal on May 17, 1982. Generally, SpaceTran proposes:

- First, to purchase Orbiter V with private funds raised in the United States;
- Second, to contract for all commercial and foreign uses of Orbiter V;
- Third, to contract with NASA for launch support services; and
- Fourth, to make Orbiter V available to the Department of Defense whenever an emergency use of Orbiter V is required;

Under our new proposal, SpaceTran does not seek from NASA any exclusive arrangement to fund additional Orbiters or to market commercial and foreign payloads.

In a broad sense, we believe that our initiative clearly reflects the intent and purpose expressed in the National Aeronautics and Space Act of 1958 which established a civilian agency so that "activities in space should be devoted to peaceful purposes for the benefit of mankind." While the 1958 Act also recognized military requirements, we submit that national security and free enterprise in space can go hand in hand.

Continued Federal funding of research and development is required if this Nation is to maintain its role "as a leader in aeronautical and space science and technology" as called for in the NASA Act of 1958. There are tremendous new opportunities in this arena through the development of orbital transfer vehicles, large platforms, and the permanent presence of man in low earth orbit. The record before this Committee on the path and scope of space industrialization is testimony to these opportunities.

While the private sector cannot provide financial support for these opportunities at this time, SpaceTran believes that its initiative could provide a model for future private endeavors. In the next decades, few areas of U.S. enterprise can be as successful as the commercial development of space if this endeavor is allowed to develop within the context of free world markets. We believe our proposal is the first significant step in that direction.

We seek your help and encouragement in aiding this venture to a successful conclusion.

Mr. FIELD. Mr. Chairman and members of the committee, on March 23 of this year, the board of directors of Prudential authorized an equity investment in SpaceTran which we view as a venture capital investment. The initial funds invested by Prudential will be used to evaluate the feasibility of large-scale private sector funding of Orbiter V, whereby SpaceTran could operate a fifth Orbiter as a business venture subject to risks that are no greater than those generally borne by commercial enterprises.

Extended negotiations and analysis will be necessary before we can decide whether or not to proceed with this high-risk project. At the same time, we recognize that maintaining the continuity and cost of orbiter production capability is crucial to the U.S. efforts to establish an efficient, reliable space transportation system on a permanent basis.

Accordingly, a high degree of cooperation by all parties will be necessary for a timely decision to proceed with the SpaceTran project. If we do proceed, a major investment, approximately $1 billion, will be required on SpaceTran's part. The form that this financing would take is partially dependent on the economics of the project, but the outline seems clear.

Prudential and possibly others would make a major equity investment in SpaceTran, but the bulk of the financing would be provided from loans tailored for repayment to match the revenue stream derived from Orbiter V launches.

Let me repeat that since we are only now in the process of assessing the feasibility of the SpaceTran project—and we view this hearing as a key milestone in our progress—Prudential considers its investment in SpaceTran to be entirely at risk.

We believe that the commercial potential of the Shuttle can only be fully realized through a marketing entity with substantial capital at risk operating outside the constraints of a government organization. We recognize that we cannot hope to reach a satisfactory conclusion to proceed with this project without the cooperation and support of the Government, even though SpaceTran contemplates no government loan guarantees or subsidies.

It is our hope that NASA, the Department of Defense, members of this committee, and the Congress as a whole would support the SpaceTran proposal and encourage serious discussion between NASA and SpaceTran.

Thank you. We are now ready for questions.

[The prepared statement of Mr. Field follows:]

STATEMENT OF

WILLIAM S. FIELD

SENIOR VICE-PRESIDENT

THE PRUDENTIAL INSURANCE COMPANY OF AMERICA

BEFORE

THE SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

JUNE 15, 1982

Mr. Chairman and Members of the Committee:

My name is William S. Field. I am Senior Vice President in charge of the Capital Markets Department of The Prudential Insurance Company of America. I am also a member of the Board of Directors of The Space Transportation Company Inc. of Princeton, New Jersey.

I am very pleased to appear before your Subcommittee to discuss Prudential's support of SpaceTran's endeavor to buy Orbiter V to service commercial and foreign users of the U.S. Space Transportation System.

The Capital Markets Department of Prudential manages a portfolio of $26 billion of short term investments, long-term publicly traded and privately placed fixed income securities,

and oil and gas exploration programs. Most of Prudential's investments consist of fixed income securities because of the nature of the liabilities of the insurance business. But we have segregated a portion of our investment capacity to encompass more risky investments such as oil and gas drilling and venture capital financing. While more risky, these investments offer higher returns and a better opportunity to try to provide a hedge against inflation.

On March 23, 1982, the Board of Directors of Prudential authorized an equity investment in SpaceTran, which we view as a venture capital investment. The initial funds invested by Prudential will be used to evaluate the feasibility of a large scale private sector funding of Orbiter V.

There are two principal areas in which the feasibility of the project has to be assessed beyond being satisfied that the capital cost of the Orbiter V is reasonable. The first is the question of whether agreement can be reached with the Government, without the need for legislation and on the terms and conditions of a contract whereby SpaceTran could operate a fifth Orbiter as a business venture, subject to risks that are no greater than those generally borne by commercial enterprises. These conditions deal with such issues, for example, as being assured that SpaceTran's Orbiter could, in fact, be launched and that, indeed, there would be a U.S. Space Transportation System in which to use it.

The second has to do with the actual demand for space shuttle flights by commercial and foreign users. Key considerations are knowledge of what launch costs to SpaceTran will be, adequate freedom to price to meet competition from Arianespace and others, and the level of confidence potential customers have in the reliability of the launch schedule.

These questions are complex because the answer to any one of them depends at least in part, on the solution of one or more of the others. Extended negotiations and analysis may well be necessary before we can decide whether or not to proceed with this high risk project. At the same time, we recognize that maintaining the continuity and cost-effectiveness of orbiter production capability is crucial to the United States' efforts to establish an efficient, reliable space transportation system on a permanent basis. Accordingly, a high degree of cooperative effort by all parties will be necessary for a timely decision to proceed with the SpaceTran project.

If we do proceed, a major investment, approximating $1 billion, will be required on SpaceTran's part. The form that this financing would take is partially dependent upon the economics of the project, but the outline seems clear. Prudential, and possibly others, would make a major equity investment in SpaceTran, but the bulk of the financing would be provided from loans tailored for repayment to match the revenue stream derived from Orbiter V

launches. Only with such leverage do we believe it will be possible for the risk-bearing equityholders to make an adequate return on their investment. To be willing to accept a fixed income return, senior lenders to the project have to be assured that their risks will not be too high. Essentially, this involves adequate safeguards that Orbiter V will be completed within technical specifications and within budget. It also means confidence that sufficient revenues will be generated to cover expenses and loan repayments. Adequate insurance against some of these risks must be obtainable at reasonable rates.

Let me restate that since we are only now in the process of assessing the feasibility of the SpaceTran project (and we view this hearing as a key milestone in our progress), Prudential considers its present investment in SpaceTran to be entirely at risk.

In view of some of my previous comments, you may well ask why Prudential feels that the SpaceTran proposal warrants the investment of any time and money on our part. I have already discussed the venture capital aspects of this proposal. These afford us an opportunity to make a fair rate of return on our investment if, in fact, the project proves to be feasible. As we told our directors, however, there is another reason.

Prudential has always attempted to be innovative and flexible in its approach to investing policyholders' funds. One aspect of this approach is a willingness to pioneer new financing ventures and techniques if these appear sound and within the Company's tolerance to bear investment risk. Our analysis indicates that space has become a major business frontier. As we look out into the future, we contemplate many opportunities to participate in this exciting new area of investment. We would like to continue our pattern of leadership in this new arena.

More particularly, we believe that the U.S. Space Transportation System will be a cornerstone in the space domain. The capabilities of the space shuttle are unique. We believe that the commercial potential of this magnificent technological achievement can only be fully realized through a marketing entity, with substantial capital at risk, operating outside the constraints of a Government organization. We think it is clearly in the national interest to maximize the resources available to support an expanded commercial space program because the tangible benefits to the Nation are vast, being limited only by the ability of U.S. technology. We would expect every responsible business leader concerned with the future of U.S. technology and our Nation's space program to echo these sentiments. We hope to be able to be an early participant in realizing this goal.

We recognize, however, that we cannot hope to accomplish this complex task without the cooperation and support of the Government - even though SpaceTran contemplates no Government loan guarantees or subsidies. It is our hope that NASA, the Department of Defense, members of this Committee and the Congress as a whole would support the SpaceTran proposal and encourage serious discussion between NASA and SpaceTran.

Mr. FLIPPO. Thank you very much for your testimony.

I would like to explore one point. Dr. Heiss, I believe in your testimony, on page 4, you said that the Arianespace had been singularly successful. I wonder if you would elaborate on that somewhat for me. I understand that that operation, if in fact it is a subsidized operation, has perhaps not reached a profitable state yet, and I wonder under what sense you would define it is as a successful venture, in the absence of recovering full cost.

Dr. HEISS. Well, we at SpaceTran are not asking for government subsidization or loan guarantees in our proposal made to NASA.

As to Arianespace's success, Arianespace has, as of today, booked 10 firm flights in 1986. They have made, since January of this year, seven firm bookings. It is my understanding that the United States has booked no foreign flights in 1982, as of May.

In total, I believe Arianespace has 24 firm orders, 13 reservations, and they are considering building up from 4 to 8 launches, and maybe up to 10 launches, in the latter half of the 1980's.

As to the issue of subsidization of Arianespace launches, SpaceTran has a full life cycle costing capability, and it is my impression that it is the policy of the Europeans to recover the full costs in their launches, and I think that is required under the General Agreements on Tariffs and Trade as well as regulations within the European community.

Mr. FLIPPO. Let me ask you directly if you believe that the current pricing policy of Arianespace recovers full costs.

Dr. HEISS. I would like to submit an answer to that question in writing if possible.

Mr. FLIPPO. Very good. We would be pleased to have it.

[Material to be provided follows:]

The success of Arianespace in marketing space launches, particularly to U.S. customers, has been attributed by some to artificially low launch prices resulting from European government subsidies to Arianespace.

A rough comparison of launch prices on different launch systems is shown in Table 1.

Comparison of Estimated Launch Service Prices

April 1986 Launch

(Millions of 1986 Dollars)

Payload Class	Shared Shuttle Price	ELV Price	Estimated Ariane Price
Delta 3920	26	39	31
Atlas Centaur			
Dual compatible	66	66	62
Shuttle optimized	41	66	62

Sources: NASA, Arianespace, McDonnell Douglas.

Although the quoted Ariane price is lower than the Delta 3920 ELV by more than 20% and also slightly lower than an Atlas Centaur ELV, one cannot conclude that Arianespace launches are priced below cost. Admittedly, it is difficult to see how the Ariane launch vehicle could

be offered in the United States at the quoted price, but Ariane is produced in Europe.

The prices quoted in Table 1 are in U.S. Dollars, but costs on Ariane vehicles are incurred in a basket of European currencies, with maybe as much as 60% incurred in French Francs. Over the past 12 to 18 months the French Franc has been devalued about 40% versus the Dollar.

Another consideration concerns productivity: in the second half of the 1970's, European Aerospace industry productivity was variously estimated to lag U.S. productivity by 20-30%. If the relative productivity difference has not changed, this would indicate that equivalent aerospace systems might cost from 20-30% more in Europe than in the United States. This factor would seem to offset any exchange rate advantages Europe may enjoy today.

Launch site differences also complicate cost comparisons. Ariane launches from a South American site which is nearer the equator and therefore more suitably located than U.S. launch sites. This advantage is somewhat balanced by the fact that the launch site is further removed from the Arianespace hardware production sites in Europe and this must contribute to higher prelaunch transportation costs.

Arianespace is clearly pursuing competitive pricing policies against American launch systems. Their prices reflect the competitive situation of the marketplace rather than the costs they are actually incurring, at least in the early development stages. They are "buying a piece of the

market". Aggressive pricing of new launch services is also being done by NASA on the space shuttle. In both cases, the pricing policy being followed reflects sound business practices in the marketing of new transportation systems.

Finally the success of Arianespace can be attributed to three other factors which may be more important than price:

1. Scheduling certainty for commercial users
2. Advantageous financing of launches and payloads
3. The private marketing approach

Financing subsidies are particularly significant and this is indeed adversely affecting the competitiveness of U.S. launch services in world markets. Efficient financing is part and parcel of the marketing of launch services. Such financing cannot and should not be provided by U.S. government agencies and yet must be available if U.S. launch services are to compete against European - and - other countries.

Mr. FLIPPO. Do you think that the pricing policy of the United States should recover costs? I was really addressing the point about the successfulness of the Arianespace program.

Dr. HEISS. Let me comment positively. I do not attribute the success of Arianespace today to cost subsidization. I do attribute the success of Arianespace to date to the fact that Arianespace can make use of the full range of tools that are important to successful marketing in world markets. This includes not only price. You have to look at financing flexibility; you have to look at marketing; you have to be there to make sales; you have to be able to enter into joint ventures.

The range of these options can only be accomplished in the United States by the private sector, and we are willing to do so.

As to our proposal to NASA, we believe it is based on very sound economic principles. These principles say that SpaceTran will reimburse to NASA all the costs that are added by SpaceTran to Government costs in operating the system.

Based on successful negotiations with NASA, we can determine with more certainty how and where we are competitive with Arianespace.

Mr. FLIPPO. Doctor, you have made studies over a number of years, and the committee is familiar with your work. I wonder if you would comment for me on the difference between additive costs and full costs and the ramifications of that.

Dr. HEISS. This is an issue throughout the pricing of transportation systems. The question of total added costs is not limited to space transportation. In space transportation, the issue comes up for the first time when you have a reusable system. If you throw away things, it is easy to determine the cost and cost allocation.

What we propose and what we consider to be within the past history of the United States in dealing with such issues—when you ask when the private sector should come in to take over transportation activities and under what rules and roles—is that the private sector should fully reimburse the Government for all the costs that the private sector causes to the Government when adding its activities to the Government activities.

There is a long history in the United States that the federally funded research and development costs, for example, are generally not recovered from the private sector. That is one key reason for the success of the aerospace industry as well as agriculture and the role of the Department of Agriculture, the two sectors where the United States has succeeded in working out Government and industry cooperation.

We believe the principles that we have proposed to NASA are sound and helpful to space industrialization, not just to our venture on Orbiter V.

Mr. FLIPPO. Mr. Field, if I might understand just a little better about your statement, on the bottom of pages 3 and 4, that Prudential has an investment to consider the feasibility of the project but that the bulk of the financing would be provided from loans tailored for repayment to match the revenue stream from the launches, and, "Only with such leverage do we believe it will be possible for the risk-bearing equity holders to make an adequate return on their investment."

Does that mean that the orbiter would be the security for the loan?

Mr. FIELD. The orbiter might be, but it is not really contemplated that the lenders would look to the security of the orbiter for repayment. We would have to have enough marketing revenue in hand or contracted for to satisfy such lenders that they would in fact be repaid out of the project's revenues, and that also means that they would have to have a high level of confidence in the projected operating expenses of the venture.

Mr. FLIPPO. Is this a new part of the proposal?

Mr. FIELD. Well, this is not really a part of the proposal as to how it would be financed. That would be at the risk of Space Transportation Co. should this project proceed as to how it was financed, and we are not nearly at the stage of putting together a package to actually finance it.

The point I wanted to make here, among others, was that Prudential would not be putting up the full amount of funds that would be required to buy this orbiter.

Mr. FLIPPO. Mr. Hollenbeck.

Mr. HOLLENBECK. We heard a reference made earlier to insurance companies not being allowed to be involved in this type of venture, but I believe that your State law is permissive of this involvement. I just wanted to clear that up.

Mr. FIELD. Yes, our State law is permissive of this type of investment, and so is the insurance statute of the State of New York, to the best of my knowledge.

I thought the comment was made with respect to writing insurance on these vehicles rather than making investments.

Mr. HOLLENBECK. Well, I don't know. I wasn't sure.

Mr. FIELD. With respect to writing insurance, there are a number of parts of this project where we would have to be able to obtain insurance at satisfactory rates before we would be willing to proceed, and to the degree that such insurance was not available in the United States, we would try to obtain it in London.

Mr. HOLLENBECK. The percentage of your investment, though, is limited by law.

Mr. FIELD. That is correct. That is the bottom line on it. But we would not contemplate that our investment would be that large as to violate that provision.

Mr. HOLLENBECK. Dr. Heiss, we heard earlier testimony both from NASA and DOD, and I raised the question prior to this of the fact that the military can, so to speak, bump any flight. Now, does this give you any problem in your projections of marketing space?

Dr. HEISS. Well, with four orbiters, indeed that is a very, very serious issue. The Air Force has testified that four orbiters are enough for military uses; hence the implication that a fifth orbiter indeed is needed to accommodate, with any certainty of launch schedules for commercial and foreign users.

Now, second, we have said and have proposed that the Department of Defense will have access to the privately funded Orbiter V when national security requires this. However, to compete——

Mr. HOLLENBECK. I just want to interrupt and ask you something there. That is your fourth item on page 5. Now, will the criterion for that emergency use be the same as the criterion under which the DOD and NASA currently operate, or are you looking for some right of appeal of that Air Force decision? I raised that earlier, too, because it bothers me that we can fall into an arbitrary situation.

Dr. HEISS. We have to reach a cooperative agreement with NASA under which this point will be fully clarified. We are saying, however, that Orbiter V will be dedicated to commercial and foreign users, which introduces certain schedule certainties that might not be totally accommodated in another arrangement.

On the other side, if the DOD does need Orbiter V for national security, our orbiter is there to be used by the Department of Defense. The details have to be worked out with NASA under the cooperative agreement.

Mr. HOLLENBECK. Now, the DOD raised an objection in their testimony on the basis of security. You were present and you heard their remark. I wonder if you could answer that.

Dr. HEISS. Well, Mr. Hollenbeck, I do not think that the Department of Defense objected to the private funding or ownership of Orbiter V in their testimony. However, I do think they have a concern: Will a private entity have access to the Department of Defense payloads or, if a Department of Defense payload were to be launched on Orbiter V, would we be around looking at it, and I can assure you that we have no such intentions.

Mr. HOLLENBECK. Now, are you proposing that we need legislation to permit this proposal to move forward, or do you only require an endorsement, so to speak, and not actual legislation?

Mr. DEMBLING. At the present time, Mr. Hollenbeck, we view the conceptual proposal that we submitted to NASA as not requiring legislation. In a review of the NASA Act of 1958 we have determined that NASA has all of the authority necessary to perform the functions contemplated by the May 1982 proposal that we submitted to NASA.

Mr. HOLLENBECK. Dr. Heiss, we hear kicked around, sometimes in the positive, sometimes in the negative, a comparison between this proposed venture and Comsat and I wonder, for the record, if you, in your background and expertise, can compare the similarities and the dissimilarities of the three. I think that might be helpful in illuminating our discussion.

Dr. HEISS. I think that Comsat was a great example set in 1962-63 in communications—regulated industry—and hence, in that sense, it is a limited precedent to what we are proposing here.

Differences between Comsat and our proposal: We are proposing a sum of, say, $1 billion at risk. The Comsat venture was heavily supported throughout the sixties with Government contracts. We are not asking for that.

And, finally, Comsat has a monopoly on international communications in space; we are not asking for an exclusive arrangement nor a monopoly on space transportation, nor do we think, in the United States, that we need that. We do not have to follow the European example in this matter.

Mr. HOLLENBECK. That is all for now, Mr. Chairman.

Mr. FLIPPO. Mr. McGrath.

Mr. MCGRATH. Thank you, Mr. Chairman.

Dr. Heiss, just to clear up a misunderstanding, if we have one, but when we spoke previously on this particular question, it was my opinion that your proposal would have included the marketing of all Shuttles. Am I correct?

Dr. HEISS. Yes. We submitted a first proposal in February 1982. We have submitted a revised proposal in May 1982. Under the original concept, indeed we did propose an exclusive agreement, but we have concluded that an exclusive arrangement as contemplated in the original proposal is not necessary given the opportunities that we see in the context of the United States and worldwide space efforts.

Mr. MCGRATH. For Mr. Field, the reference to New York State—I am just going to make a statement—there was a prohibition at this point for life insurance companies that can be taken care of with a regulation from the superintendent of insurance, if you will, to allow life insurance companies to underwrite ventures such as space vehicles. Right now they can underwrite airplanes, but they don't consider in the definitions Shuttles to be airplanes.

Let's get into a basic policy question, and that is simply why should the American taxpayer, after spending more than $10 billion in taxpayer money in research and development for a space transportation system, turn over any part of that to your company without some provision for recouping?

Dr. HEISS. You raise a broad and very important issue. You are looking at 65 years of history in aerospace, 100 years of history in the case of the Department of Agriculture.

Two very significant studies have been made relevant to this issue. One is Project RADCAP in the mid-1970's, a joint study by the Department of Defense, NASA, and the Department of Transportation, which showed that 90 percent of all major advances in aeronautics from 1925 to 1972 were Government funded and sponsored.

Also, from 1966 to 1977, 82 percent of all applied aerospace R. & D. was funded by the Federal Government and not recouped.

In addition, the "National Transportation Policy Study," which looked to the past and the future of U.S. transportation, pointed out that the total funding of applied—applied, not basic—research and development in aerospace, just from 1970 to 1979, was $60 billion, none of which is recovered.

Applied R. & D. funded by the Federal Government in aerospace constitutes 82 percent of the funding of applied R. & D. done in aerospace. The results of that policy for the past 50 years have been spectacularly successful, first under NACA and, since 1958, under NASA.

Your question goes to the heart of an issue that has been discussed before this committee at length, and the committee has been supportive, strongly supportive, of Federal funding of applied research and development.

We, SpaceTran, propose to follow that successful policy established over the past 65 years. I do not think an exception should be made in the case of space industrialization; rather, I think we should set a precedent to follow past history. In that case, I think space industrialization, not just Orbiter V funding, can and will be successful.

Furthermore, we do not propose an exclusive arrangement. We are not buying the technology. The rights to the technology will reside where they are today.

Finally, anybody else is free to come and fund additional orbiters. We think we have a good idea. We have studied the facts and figures, and we believe strongly that our proposal follows sound economic principles which have been applied elsewhere in the few areas where today the United States is still successful in international and world markets.

Mr. MCGRATH. I guess you were prepared for that question. [Laughter.]

You must have read my mind.

Your counsel took me a little bit by surprise by saying that no legislation would be required for the administration to enact this type of proposal. I was informed by counsel that this is not the same information we have, there was a problem with the Anti-Deficiency Act which prohibited this type of venture because of no money being appropriated for this type of situation. Could you respond to that?

Mr. DEMBLING. I would like to, Mr. McGrath.

With regard to what I stated earlier, the NASA Act provides for cooperative agreements. Such agreements have been utilized by NASA since the early days of the agency. NASA is authorized to

provide services to the private sector and to be reimbursed for that service. Furthermore, NASA may retain the funds received from the private sector and is not required to turn them over to the Treasury Department's "miscellaneous receipts" account.

This was done early on in NASA in the Telstar project which was launched for A.T. & T., and the practice has been continued by NASA.

Second, with regard to NASA's authority to establish and charge fees for launch and associated services, that has been done under section 203 of the NASA Act for many years, and it is under this provision that they can and do provide services and do charge for them.

In addition to that, there is a provision in the NASA Act that talks about providing services to a whole list of organizations and organizational entities that deals with their providing services with or without reimbursement. We are not talking about the without reimbursement; we are talking about with reimbursement.

With regard to your question as to the Anti-Deficiency Act, there is no aspect of SpaceTran's proposal where NASA is required to put up any money or obligate any funds before they have been appropriated. I do not see the application of the Anti-Deficiency Act since SpaceTran is not requesting any obligation of Government funds for its proposal in advance of appropriations made therefor.

Mr. MCGRATH. We will be back with you on that one.

For Mr. Field, since Prudential would only contribute a minority of interest in SpaceTran and put up a limited amount of the actual money necessary, what assurances has your company been given, that the rest of the financial backing can be found?

Mr. FIELD. We have no assurances at this point in time. The potential to finance this project is a function of negotiating a satisfactory cooperative agreement with NASA, with the solution to a host of problems having to do with projected income and the projected expense for this project.

As I indicated in my testimony, at the present time this project is a venture capital project, and there is seed capital in it. We need to do a lot of homework, and we need to—but the key to it is a satisfactory arrangement whereby we will know what our costs are going to be so that we can go out and market this capability.

Mr. MCGRATH. In your discussions with Dr. Heiss or anybody else who is a protagonist here in SpaceTran, there has been no discussion as to where the rest of the money is going to come from?

Mr. FIELD. Well, we have some certain conceptual ideas that if we can put this together in the right way, that we will be involved in what is known as a project finance venture whereby we would expect banks would be willing to put up senior money, perhaps other insurance companies, but we are way before the stage of coming to grips with that; we have got other problems.

If the project is put together in the right way, we firmly believe that it is financible.

Mr. MCGRATH. Dr. Heiss, why can't NASA market the Shuttle for commercial use to foreign and domestic users?

Dr. HEISS. First, I would like to compliment NASA on the overall effort done to date, but any Government agency, I believe, operates

under severe constraints that limit its ability for worldwide marketing of any service; also space transportation services.

The key to marketing success is manifold; it cannot be reduced to only one answer. Price has been mentioned before. I think that under the new pricing policy proposed by NASA, the Shuttle will be competitive with expendable launch systems. But price is not the only item that decides whether a user will fly on the Shuttle or fly on an expendable system: The certainty of launch, the scheduling, priority of others in bumping commercial users, and most important, financing, availability of financing, possibility of entering into joint ventures as Arianespace has done are other determinants.

The fact that SpaceTran will have money at risk, as a private entity, is an important item which does shape the marketing approach. Having looked at the question of marketing for at least the past 3 years, having also testified on the same issue in 1979 before this committee, the following has come true: The Europeans have created a private entity for marketing of their system in world markets starting from a lower technology base, much less than we have in the United States, and yet they have been successful in their private approach.

I think there lies part of the answer to your question. We are not proposing, however, again, a single entity. NASA is looking at the issue of how to market the Shuttle independent of our initiative. But at the heart of our initiative, indeed, is the marketing of the Shuttle in world markets.

Mr. MCGRATH. NASA has a manifest for the four Shuttles at this present time through, I guess, into the 1990's, and since your presentation includes only one now, would it not be possible that NASA would be in some sort of competition with you for the same?

Dr. HEISS. Well, we propose that NASA do a splendid job for the Government and private industry do a splendid job for private industry. No, we do not see a conflict between NASA's operations of the Shuttle and the private approach to marketing. There are [illegible] roles that obviously are mutually supportive of a fifth Shuttle that is privately funded and a Government-owned fleet of four orbiters.

Mr. MCGRATH. Well, if a third would be dedicated to DOD, that would leave two-thirds for whatever research and development and, up to this point anyway, commercial use. Now, how are you going to fit with a fifth orbiter dedicated solely, except in time of emergency, to commercial uses and be left with, at best, two-thirds designed for R. & D. I am not sure we have that many R. & D. projects scheduled for orbiters over the next 10, 12, or 20 years.

Dr. HEISS. Well, I think NASA is more qualified to answer that question, but let me be responsive to your question.

Mr. MCGRATH. What I am saying to you is, are all commercial flights of all Shuttles going to be flown in the fifth orbiter, the one that you own, and the rest of them, whatever NASA wants to do with the other four absent the dedication of 30 to 40 percent to DOD is up to themselves?

Dr. HEISS. No, we are not saying that. We are saying that any privately funded Shuttle should have the first use of commercial and outside users in the system. We see substantially larger uses

from the outside world of the U.S. space transportation system than can be accommodated on one orbiter.

I think that, again, the Government fleet can accommodate them, or I would expect that other private entities, as they look at these same opportunities, may come forward and accommodate the growth in demand by funding orbiters.

But let me come back to the percentage figures as to the demand made of the four orbiters. I have looked at the mission model of NASA and other agencies over the past 10 years. The demand by the Department of Defense, for example, has varied anywhere from 30 percent to maybe 50 percent, sometimes even less than 30 percent. It very much depends on what traffic do you include when you look at the percentages.

If we do not capture any commercial and foreign users of the shuttle, I would submit the percentage use of the Department of Defense will exceed 30 percent.

On the other side, if the National Aeronautics and Space Administration is given an exciting new goal in space leading to platforms, large communications systems, and geosynchronous orbit for the later half of the 1980's, I think a Government fleet of four will be insufficient to accommodate the Government demand for space users.

We are saying that we have identified a specific commercial and foreign market which needs, in capacity, 20 to 25 percent of the total fleet of five orbiters. We are saying that the private sector fund that capacity represented by the fifth orbiter and accommodate that demand with commercial principles in marketing the system, financing launches. We think this approach will be successful.

But we are not saying SpaceTran wants an exclusive marketing role, nor do we say that SpaceTran will be the only ones carrying commercial and foreign payloads. It depends on what the demand for the system will be from commercial and outside users. In fact, we think such demand will exceed the capacity of Orbiter V very quickly.

Mr. McGRATH. At what point in the price of an orbiter do you withdraw your proposal?

Dr. HEISS. I would reserve that to our discussions with NASA and Rockwell.

Mr. McGRATH. When are the details of your proposal going to be available to the committee and the public?

Mr. DEMBLING. We are just starting discussions. In fact, we received a letter dated June 8 from NASA Administrator Beggs stating that they will be starting discussions with us soon. We would like to reserve public disclosure of the proposal until we have some agreement with NASA, and then we would be very happy to submit all of the information to the committee as desired.

Mr. McGRATH. To whom has this proposal been made to this point?

Mr. DEMBLING. The proposal has been made to NASA——

Mr. McGRATH. Strictly to NASA?

Mr. DEMBLING. Yes, sir.

Mr. McGRATH. There has been no Cabinet counsel involved in this?

Mr. DEMBLING. No, sir.

Mr. MCGRATH. I have no further questions.

Mr. FLIPPO. Mr. Winn.

Mr. WINN. Thank you, Mr. Chairman.

Dr. Heiss, could you just tell us briefly what are the differences between your old plan and your new proposal and why you have changed. What are the basic changes.

Dr. HEISS. The original proposal that we contemplated as early as 1979 was modeled roughly after the example of Arianespace, where the entity, the private entity, would have the sole and exclusive rights to market the total system to commercial and foreign users.

Looking at the potential, looking at the issues involved in this country, we think that we do not need exclusive rights nor a monopoly as to the funding of orbiters or the marketing and contracting for commercial and foreign users.

That is the principal reason of the change between the February and the May submittal.

Mr. WINN. Did you also think that might not sell or fly? [Laughter.]

Dr. HEISS. Let me be very explicit and responsive to your question.

We think that setting up an organization like Arianespace here would probably require a process anywhere from 1 to 2 years, if not longer, if such an entity, under antitrust laws, even can be contemplated.

Second, while originally we thought that such a venture indeed would require such monopolistic exclusivity, we have now come to the conclusion we do not need it. We were concerned and are concerned seriously with the costs of Orbiter V as the funding question gets delayed, and our initiative, Mr. Winn, got started back in 1978 when the Office of Management and Budget made the decision not to fund Orbiter V. Let me say, we took some risks going out and finding out what is possible in terms of a private initiative. We have put in 3 years of detailed work on the cost structure, other issues involved, economic principles, and we believe, with 12 years of strong experience on Shuttle and Shuttle economics, that this venture now is timely and should be undertaken, and that is why we submitted the proposal.

We do not think that an exclusive arrangement is necessary; rather, let each aerospace company and us go after these markets, and we will be happy to fly their payloads on our orbiter.

Mr. WINN. Well, I commend you on your initiative, and I am sure that there may well be some additional changes in your plans as things progress and as you negotiate and discuss it more in depth with NASA on some of the problems.

Dr. HEISS. Right.

Mr. WINN. I would be surprised if there weren't some additional changes.

Mr. Field, on page 4, you said:

> Let me restate that since we are only now in the process of assessing the feasibility of the SpaceTran project, and we view this hearing as a key milestone in our progress, Prudential considers its present investment in SpaceTran to be entirely at risk.

I think I know what you mean by that, but it also sounds, and certainly you might like to elaborate on it, like you are leaving yourself an out.

Mr. FIELD. We have made no decision, Mr. Winn, to proceed with this project beyond the point of authorization at the present time of our board of directors, which is to explore the feasibility of the project, and if we conclude anywhere along the way that one aspect or another of this project is not feasible as far as we solely are concerned, we will cease our participation in the project.

Mr. WINN. Well, that is one of the things that I wanted to clarify because I think the fact that you are here and appearing at the table with Dr. Heiss, and the established fine reputation of your company, adds obviously to the prestige of these hearings.

I had the feeling that you were leaving yourself an out there, and I wanted to clarify that.

Mr. FIELD. But it certainly is not with the purpose of trying to leave ourselves an out. We would like to see this project proceed and become a successful project because we think that space will be a major business frontier in this country in the next 50 years, and we would like to continue our leadership role in participating in new business ventures that make sense and that give us the proper opportunity to benefit our policyholders in a worthwhile manner.

And so we are not trying to leave ourselves an out; rather, we are trying to be sensible businessmen and make this project work, but if it does not work, we obviously have to have an out.

Mr. WINN. There won't be many mortgage loans involved in this project. [Laughter.]

Mr. FIELD. No, sir.

Mr. WINN. Thank you very much. Thank you, Mr. Chairman.

Mr. FLIPPO. Thank you, gentlemen.

Considering the history and experience of this country in the development of the railroads, investments in the highways and the waterway systems, airlines and aerospace, the Nation has always approached each of these transportation systems in a somewhat different but somewhat similar fashion as well.

I, too, want you to understand that I don't think we are trying to sound negative, but we are treading on somewhat new grounds with some very difficult issues.

I want to also congratulate you on your initiative and your foresightedness, and I think you already understand that what the members of this committee want is to be assured that whatever agreement is reached represents an equitable solution for both the taxpayer and your company.

Thank you very much for your testimony today.

Mr. Hollenbeck, did you have a closing comment?

Mr. HOLLENBECK. Yes, Mr. Chairman.

I want to thank the chairman for conducting these hearings and thank our witnesses who came today from a great State.

You gentlemen, along with the other witnesses, I think, underscore the dilemma that a lot of us face. We complain about the subsidies, the government subsidies that the French have and the Japanese have, and so on, and at the same time we rail against bailouts and subsidies here in this country.

I think that these hearings underscore the need for this subcommittee, among others, to really assess its role in, in this case, helping to keep our space transportation system competitive with other countries for both foreign and commercial use and how to involve the private sector in these activities without a bailout but yet encouraging them or giving them the carrot to come in.

I hope, Mr. Chairman, that we will be taking further action in this regard in the future, whether it be by future hearings or necessary legislation.

Mr. FLIPPO. Mr. McGrath.

Mr. MCGRATH. I clearly think that this has been one of the most important hearings that we have had in the 2 years that I have been on this committee, and I know for me it has cleared up quite a few of the misconceptions I had about the program and the proposal, although there are many more, as we have discussed in private and through correspondence.

However, I do think that this has been a good hearing. I congratulate the chairman for having it, and I think we ought to have another one.

Mr. FLIPPO. Thank you.

I assume the gentleman is saying that Government is a part of the solution.

Thank you very much for your testimony. The subcommittee will be in recess.

[Whereupon, at 5:22 p.m., the committee recessed, to reconvene at the call of the Chair.]

[Answers to questions asked of Dr. Heiss and Mr. Field follow:]

QUESTIONS AND ANSWERS

Question No. 1: If NASA acquires a fifth orbiter, will SpaceTran be interested in purchasing the sixth orbiter? At what point does te NASA fleet size become too large to make the STC proposal uneconomical?

Answer: SpaceTran is interested at this time in acquiring Orbiter V and has not determined its course of action, should NASA acquire a fifth orbiter.

Question No. 2: What sort of legislation would be required to allow the SpaceTran proposal to move forward? Do you only require an endorsement from Congress and not legislation?

Answer: In May 1982, SpaceTran proposed a Cooperative Agreement with NASA. It appears, based on legal analysis, that NASA has the requisite legislative authority to enter into such Agreement and to perform the functions that such an arrangement contemplates. An endorsement of the concept from the Congress or its appropriate Committees would be helpful and we will welcome full review by Congress of whatever Cooperative Agreement we reach with NASA.

Question No. 3: Why can't or shouldn't NASA market the Shuttle to foreign and commercial users? Do you believe a company like SpaceTran can more effectively market the reusable STS?

Answer: NASA is marketing the shuttle to foreign and commercial users. Nothing in SpaceTran's proposed agreement with NASA precludes NASA from continuing to do so.

We believe SpaceTran, or any other private entity with substantial money at risk, can utilize certain marketing techniques not available to a government entity. Advantages of private marketing

include a competitive pricing policy reflecting financing capability and the possibility of joint ventures with potential users. SpaceTran intends to follow an active marketing approach similar to that pursued by Arianespace, which itself is a commercial and private entity.

Question No. 4: Can the Space Shuttle compete with Ariane? Without the SpaceTran concept or with it? What is the relationship between European subsidization of Ariane and the SpaceTran proposal? Under the SpaceTran proposal the government would absorb some overhead costs. Doesn't this amount to a subsidy?

Answer: The space shuttle can compete with Ariane once commercial and other non-United States Government (USG) users have confidence in the shuttle capabilities, particularly launch schedule reliability. The competitive position of the space shuttle system will substantially improve with an orbiter dedicated to such non-USG uses. In addition, financing and joint venture arrangements with potential shuttle users and payload investors will increase the range of competitive markets of the shuttle versus the European system. In our view, a private entity for the marketing, contracting, and financing launches is warranted to make the space shuttle a commercial success. This is all the more so when that company has substantial funds at risk. This is the SpaceTran concept.

SpaceTran does not believe that a clear-cut case of Ariane subsidization can be made based solely on the advertised price per launch.

SpaceTran proposes to reimburse the Government for the total cost added for its uses of the space shuttle system. SpaceTran proposes an equitable cost reimbursement arrangement with the Government based on long-standing precedent and tradition.

The SpaceTran proposal is fully within the spirit of various Office of Management and Budget circulars dealing with pricing and procurement issues. In addition, it is consistent with the spirit of the letter on this subject from the Director of OMB to the NASA Administrator, dated June 14, 1982.

Question No. 5: If you put up the $1 billion or $1.5 billion and, for whatever reason, the fifth orbiter costs grow to $2-$2.5 billion, what provisions have been made in your proposal to accommodate this growth?

(a) What happens if the venture folds? We understand that the Space Shuttle title goes to the U.S. Government, but what provisions have been made to protect the customer? Does the U.S. Government incur any liability?

Answer: SpaceTran proposes to fund one orbiter, the cost of which should be fairly reasonably determined for purposes of our proposed Cooperative Agreement with NASA. It will be necessarily based on the costs of the prior four orbiters. SpaceTran sees no reason why a hardware item estimated at $1 billion (1982 dollars) should escalate to $2 or $2.5 billion. All of SpaceTran's economic analyses have assumed a cost of $1 billion.

SpaceTran proposes to take title to the space shuttle purchased and financed by Spacetran. SpaceTran proposes a Cooperative Agreement with NASA that does not involve any explicit contingent liabilities by the U.S. Government. SpaceTran plans to obtain insurance in the world market for its various physical and economic risks.

Question No. 6: Can we expect the taxpayer to accept the idea that after investing $15 billion in the Shuttle system the government would sell a new Orbiter to SpaceTran for a fixed price; and make a significant profit by marketing its use? Why?

Answer: This question was answered in detail in our Dr. Heiss' testimony before the Committee. The long-standing precedents were recited dealing with, among others, aircraft research and development funding and the respective roles of Government and private industry in the utilization of such technology.

SpaceTran is not proposing to acquire the exclusive rights to the technology of the Space Transportation System. This technology is in the public domain. Any other entity is free to utilize the technology or to purchase an orbiter if it so desires. When the private sector is technically and financially capable of providing its resources to operate a program, the policy of the Government in the past has been to permit private enterprise to engage in such activities. The SpaceTran proposal follows that precedent.

Private investment in the Space Transportation System is possible only if the expected return justifies the risk of the investment. While we believe the market exists to generate adequate revenue for a return on the investment, this still remains to be demonstrated. Since SpaceTran is not seeking any exclusive uses or exclusive arrangements with the U.S. Government, demonstration of demand may well lead to added private competition in the very field chosen by SpaceTran. Hence, SpaceTran expects to bear the financial burden of its proposed venture. This is the investment risk determination it must make and is the type of decisions made by U.S. companies constantly.

Question No. 7: What would happen to ELV's under SpaceTran's proposal?

Answer: SpaceTran is not asking for any limitations on ELV uses. Private initiatives in ELV's should be treated neither more nor less favorably than the SpaceTran proposal. Under similar terms and conditions the space shuttle is competitive with expendable launch vehicles.

Question No. 8: If SpaceTran expects to recoup its investment by paying NASA a "reasonable price" (which is assumed to be essentially additional cost) for commercial launch support and selling these same services on the open market, the government will have to fund all of the fixed operating costs rather than split the fixed costs among all users. The taxpayer will tend to view this as a government subsidy to SpaceTran activities -- not only by virtue of the operating costs -- but also because SpaceTran did not contribute to the system development costs. Won't they therefore tend to look at this proposal as an agreement to loan the government the price of an Orbiter with an open ended opportunity for (and almost an assurance of) a very high rate of return?

Answer: SpaceTran proposes to reimburse the U.S. Government the cost added by non-USG users of the Space Transportation System to the costs that the Government would have incurred notwithstanding SpaceTran's proposal. The added costs to be reimbursed to the Government will include costs for additional facilities and operations. The research and development cost of the Space Transportation System was a commitment of the Government to create a national resource available to all U.S. citizens. SpaceTran's proposal does not include either exclusivity for marketing of the shuttle fleet or financing of orbiters. Hence, only competitive rates of return are expected reflecting the risk of the SpaceTran proposal.

Question No. 9: Since we understand that science and all knowledge builds upon itself, we can probably expect future developments and improvements as the Shuttle is used. Will such advances have to be ignored, under the terms of the contract, to insure STC of not being left with an obsolete space transportation system?

(a) What claims would STC have against NASA, under the terms of the contract, if an improvement or separate development rendered their orbiter obsolete?

(b) What effect would this situation have upon the nature of Shuttle related R&D work, the use of R&D work and for research in areas that could develop into competition for Orbiter V?

Answer: SpaceTran does not propose to foreclose any further development of the shuttle system or any new or improved space launch capabilities. SpaceTran is willing to accept the risk of technological obsolescence and does not propose any claims against NASA for such.

SpaceTran is not insisting on any limitations as to space shuttle related research and development work or areas which would lead to competition for Orbiter V.

Question No. 10: STS users have expressed dismay over the complicated launch agreement process required by NASA. Would SpaceTran make this process any easier?

(a) Do you only market the cargo space or do you provide services which interface between NASA and the customer? What services will you provide?

Answer: SpaceTran hopes that it can simplify the contracting for space launch services by becoming a "single stage" marketing and contracting entity. SpaceTran plans to offer launch services assistance in connection with payload requirements, and assistance for launch insurance, payload integration services, and other related services.

Question No. 11: Since SpaceTran is a new company, what marketing expertise can you demonstrate?

Answer: The marketing and sales approach by SpaceTran will depend on the terms of the Cooperative Agreement between SpaceTran and NASA.

Pending that agreement, SpaceTran is pursuing various options with regard to marketing to space shuttle users. Among these are: (1) a worldwide sales and marketing organization of its own, (2) arrangements with aerospace firms for the marketing of SpaceTran services,

(3) joint ventures with specific aerospace and marketing groups, (4) a coalition of U.S. companies and SpaceTran to provide an integrated marketing approach of space shuttle services.

Fundamental to the marketing success, and the confidence by SpaceTran to be able to provide these critical services, are (1) reliability of schedules for launches, and (2) the financing of space missions including possibly joint venture agreements with space users.

Question No. 12: If your proposal were accepted, would you expect to charge a fixed price to all customers or a variable price?

Answer: SpaceTran expects to price its services competitively with other systems and to charge the same price for the same services when provided under the same terms and conditions. However, the particular needs of different customers may vary widely and such needs will have to be considered.

Question No. 13: Do you foresee any problems with marketing to foreign customers?

Answer: No. Indeed it is expected that the particular strengths in the SpaceTran approach to marketing will have particular appeal to foreign customers.

Question No. 14: We understand that, with regard to the the Solid Spinning Upper States, many customers would prefer dealing with NASA rather than the private sector developer. How would you overcome this seeming customer preference for dealing with a government agency rather than a private sector organization?

Answer: SpaceTran is confident that it can reach an understanding with NASA and private sector developers of other stages with regard to the precise interface among customers, the suppliers of hardware, and the operator of the Space Transportation System (NASA) when providing complete integrated space launch services. SpaceTran's market research strongly indicates that customers prefer a single entity to provide the full range of the services required.

Question No. 15: What is the impact, if any, of NASA's revised pricing policy on your proposal?

Answer: NASA's revised pricing policy does not hamper SpaceTran's proposal to proceed cooperatively with the private financing of an orbiter. When NASA's prices are compared with what is considered competitive price structures for shuttle services, the views of NASA and SpaceTran are quite consistent.

Question No. 16: Does the fact that the military can bump any shuttle flight give you any problems in marketing space to clients?

Answer: The scheduling of commercial and other non-USG users on the Space Transportation System under government operation as now perceived by the commercial community has great disadvantages to market the system effectively. SpaceTran's proposal would dedicate Orbiter V to non-USG users. This can result in assured scheduling and this, in turn, will alleviate concerns by non-USG users with regard to schedule reliability and availability for non-USG uses.

Of course DOD would have access to Orbiter V in case of national emergency. The specific arrangement of the access by the Department of Defense to a privately financed orbiter has to be determined. It is our view that schedule reliability for commercial users can be substantially increased even when military needs may pre-empt any other uses of the space shuttle system.

Question No. 17: If you did not get an agreement to dedicate a shuttle to commercial use, would you still be willing to provide the financing to purchase a shuttle?

Answer: The SpaceTran proposal contemplates the dedication of the privately financed Orbiter V to commercial and foreign use. Acceptance by SpaceTran of other variations would depend on the details of such a proposal.

Question No. 18: Under your proposal who will own or have title to the 5th orbiter? Will there be liens on the orbiter?

Answer: SpaceTran proposes to purchase and finance Orbiter V and hence have full title to the Orbiter. The precise financial structure of Orbiter V will have to await the details of the understanding and agreement with NASA.

Question No. 19: Will SpaceTran pay the whole price for the 5th orbiter? Alternatively, do you expect the government to pay any part of the purchase price?

Answer: SpaceTran has proposed to pay the cost of Orbiter V and not to seek any part of the purchase price or any loan guarantees from the Government.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

SUPPORT MATERIAL TO SPACETRAN QUESTION #4

JUN 14 1982

Honorable James M. Beggs
Administrator
National Aeronautics and
Space Administration
Washington, D.C. 20546

Dear Mr. Beggs:

Thank you for your recent letter advising us of your intentions to implement a revised Shuttle pricing policy for commercial and foreign users that would apply after 1985.

We recognize the importance of establishing as soon as possible a pricing policy for commercial and foreign users that would apply after the initial three year "introductory offer" period of the current policy expires in 1985. We are generally supportive of the proposed approach which, as we understand it, would base the minimum price to non-USG users on the additive costs of flying them on the Federal Government's Shuttle fleet. However, we believe it would be helpful to make clear the basis for our views.

The Federal Government undertook the initial development of the Space Shuttle technology based upon the projected benefits of the technology to all classes of users, USG, commercial and foreign. However, we believe that it should not be assumed that the USG should have responsibility to fund an operational system with sufficient capacity to meet non-USG needs once the Shuttle technology is developed.

Generally speaking, when circumstances justify the funding and management of an operational system by the USG that is also sought by non-USG entities, the USG should limit its role to making available system capacity which exceeds its own needs. The price at which this capacity would be made available to commercial and foreign users should then be established so as to minimize the overall cost to the Federal Government of meeting its own needs in the long run.

We understand that the lowest costs per flight to meet long run USG needs may be achieved by utilizing the excess capacity of the Shuttle system. Given the projected "learning curve" benefits as the Shuttle transitions towards routine operations in the mid-1980's and the expected excess capacity of the Shuttle system over planned USG flight rates, it would seem desirable to have the excess capacity used by commercial and foreign payloads.

On this basis, the appropriate price for excess Shuttle launch capacity after 1985 would appear to be the one that:

- o Is the highest price at which sufficient users will be available to utilize the excess capacity of the Shuttle system after USG user needs are met.
- o At least covers the additive costs of the USG to operate the Shuttle system for non-U.S. Government users.
- o Does not in itself lead to the demand for funding of additional capacity by the USG (e.g., additional orbiters, ground support systems).
- o Does not discourage or compete unfairly with possible private sector initiatives that would invest wholly or partially in Space Shuttle technology in order to service growth in the commercial and foreign user market.

As we understand it, the proposed pricing policy would price the Shuttle system at additive costs during the 1986-1988 period, with the expectation that productivity improvements during the period would allow the subsequent price of excess capacity to commercial and foreign users to be on a full cost basis without any significant increase in price.

It appears to us that it is possible to begin now to implement the proposed approach and remain consistent with the principles we have noted above. Therefore, we believe it would be appropriate to allow now for yearly adjustments to the pricing guidelines that would apply after 1985 in the event that either of the following conditions is projected to occur:

- o Commercial and foreign demand for Shuttle launches appear sufficient to allow a price higher than additive costs and still fully absorb excess Shuttle capacity (e.g., problems with competing alternatives, or unexpected attractiveness of the Shuttle at additive cost pricing).
- o Problems with the Shuttle and the priority needs of USG users indicate a likely curtailment of the excess capacity of the Shuttle.

We, therefore, recommend that the new pricing policy be implemented, subject to the above considerations, so as to encourage early private sector investment and to retain the flexibility to make future periodic price adjustments for commercial and foreign users so as not to restrict the Administration's options in the future funding of the space program.

Sincerely,

David A. Stockman
Director

National Aeronautics and
Space Administration

Washington, D.C.
20546

Office of the Administrator

JUL 2 1982

Honorable David A. Stockman
Director
Office of Management and Budget
Executive Office of the President
Washington, DC 20503

Dear Mr. Stockman:

I was very pleased to receive your letter of June 14, 1982, which supports fundamentally the implementation of our revised Shuttle pricing policy for commercial and foreign users. We agree on the basis for establishing the price which includes a substantial margin over estimated costs to ensure that the U.S. Government will not incur additional costs for launching non-U.S. Government missions. However, our fixed price is based on an estimated average cost over the period 1986-1988 and will apply to launches during that period. We have taken this approach in order to provide a firm planning base for users, many of whom must design payloads for launches over several years and require some assurances that the launch cost to them will be stable for a reasonable period of time.

I feel confident that the policy we have developed will provide the Space Transportation System a competitive position relative to foreign expendable launch vehicles and that it preserves the basic principle of maximizing cost recovery to the U.S. Government.

Sincerely,

James M. Beggs
Administrator